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Forthcoming Events.

MAY 1.

Junior Institution of Engineers:—Lecturette in London. "Pumps and Pumping Problems," by A. A. Fairfax.

Institute of Cost and Works Accountants:—Fourth annual costing conference.

Midland Institute of Mining Engineers:—General meeting at Leeds. "The Burrell All-Service Gas Mask." Paper by Professor J. A. S. Ritson, D.S.O., and Mr. Hartley.

Institute of British Foundrymen (Lancashire Branch):—Ordinary meeting at Manchester. "The Importance of Venting, with Special Reference to Defective Castings." Paper by E. Longden.

MAY 2.

Institute of British Foundrymen (London Branch):—Visit to the works of Skefko and Davis Gas Stove Works at Luton.

MAY 6.

Institute of Metals:—General meeting in London. "The Motion of Electricity in Metals." Paper by Professor Dr. H. A. Lorenty.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.
PRESIDENT, 1924-25, R. O. Patterson, Blaydon-on-Tyne.
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Welsh Engineers' and Founders' Association.
Secretary: F. J. Griffiths, 20, Fisher Street, Swansea.

Foundry Trades Equipment & Supplies Association.
Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

The Protection of Eyes in Industry.

The Americans evidently have devoted much more attention to the question of protection of the eyes of industrial workers than in Europe, and a careful perusal of the trade literature issued in this connection is very convincing from almost every aspect. Primarily and obviously it is humanitarian; secondly it is a cheap form of insurance, and finally it pays. Whether there is such a pressing need for a campaign in this country as in America is open to question, as generations of factory life in Great Britain has created an inherent "safety-first" sense amongst even the least skilled. We have often noted with pleasure the wonderful ability of the British labourer to rise to the occasion when a dangerous situation has come about, and his unfailing sense to do the right thing. Experience we have had with South European labour has taught us that this useful "safety-first" instinct is entirely lacking. We have known of men fastened in the mould-drying stove overnight; a man receiving a stream of steel in the middle of the back, and many other similar accidents, which we cannot conceive happening in this country. As such men form a considerable proportion of the common labour in American industrial life, it is obvious that their problem is more acute than ours. But it must not be inferred that accidents would not be reduced in this country through the wearing of safety goggles. An advertisement for an American furnace goggle prompted us to examine our old blue furnace glasses, which bear considerable evidence of having been on many occasions splashed with liquid steel, any one of which might have proved serious. Most melters' glasses bear similar evidence, but generally speaking little risk is taken. Sharp grit, burred-up ends of pricker bars, a chip from a lathe or chisel can be equally as dangerous as liquid metal, but less care is taken because of infrequency. One telling American "safety-first" poster relates to a foreman mechanic asking a turner why he does not wear his goggles, and being answered by an explanation that he had worked on the machine six years without an accident, to which the foreman replies: "Then you are six years nearer to one."

We have made ourselves familiar with the many varieties of goggles now available for industry, and we believe that any objection against the wearing of goggles, other than frivolous ones, can be met. Ventilation, sight correction, diminution of the admission of actinic rays, weight, comfort, perspiration removal, reinforcement by the insertion of a stratum of celluloid, electric conductivity, and high impact-resisting glass have all received the attention of men *au courant* with industrial conditions. The whole situation with respect to the general industrial use of safety goggles may be prejudiced through the initial supply of unsuitable glasses. The confidence of the employee must be gained at the inception, and perhaps direct contact with the specialised form should be allowed, if not encouraged, because after all the wearing of glasses is rather a personal matter.

No department of industry presents more varied types of dangers to the eye than the foundry trades. Melting, teeming, fettling, sand-blasting, and welding each present their unique problems, and the closest co-operation should be established between the specialised firms and the foundries.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Conference on Castings for Diesel Engines.

To the Editor of The Foundry Trade Journal.

Sir,—Although unable to be present, I have been extremely interested in the discussion at above Conference, and shall be glad if the following remarks may be included in the Transactions.

It was mentioned by Mr. Donaldson that chromium cast iron showed a small contraction after prolonged heating. It appears to me that too little notice has been taken of the fact that certain cast irons, not only chromium-containing ones, show this contraction. Cast iron exhibiting this phenomenon cannot be permitted for Diesel engine work. In saying this, I am aware that some of the most-talked-about irons, for this purpose, have shown a contraction, to their very great detriment.

Regarding low-phosphorus content, fluidity and so forth, they are matters not worth discussion nowadays. The time is here when the foundryman must make sound castings of good Diesel metal, and, even if the iron contains no phosphorus at all, it will, if it is what engineers require, have to be used. In saying this I am not advocating hematite irons, but merely pointing out the foundry position as it now stands.

It is obviously absurd for anyone to talk about casting heavy pieces *in such manner as to avoid phosphide segregation*. Nobody has ever seen a piece of cast iron containing phosphorus under the microscope in which the phosphide showed a homogeneous distribution and size, and nobody has ever seen phosphide in the metal at the top of a big casting having precisely similar size and distribution to that in the metal at the bottom of the same casting. I speak, of course, of cast irons containing what is called low phosphorus, namely, round about 0.4 per cent.

In a Paper before the Institute of Marine Engineers some years ago I pointed out the undesirability as yet of rejecting the cupola in favour of reveberatory or electric furnaces. Our present knowledge of cupola-melted iron is extremely limited, and, until we know more, we should not take the attitude of scrapping this cheap method of melting iron in favour of any more expensive process.

Mr. Vincent suggests the abandonment of cast iron and the use of steel for large internal-combustion engines, and quotes the case of automobile and aero engines. I think Mr. Vincent cannot be *au fait* with the problems under discussion and the work which has been done. He mentions the present limits of internal-combustion engines as being 300-400 lbs. per h.p., which makes a 1,000 h.p. per cylinder engine, 180 tons weight. I suggest that until Mr. Vincent specifies the exact parts of such an engine, which should take 40 tons (*i.e.*, 90 lbs. per h.p.) instead of 180 tons, the argument has no foundation. He says that the marine world is very conservative, but should not hesitate to adopt proved practice. It does not.

Mr. Richardson has struck the right note in saying that cost should come into this discussion, because obviously the immediate method of attacking the problem is to try to see what we can do with that cheap metal called cast iron when melted in the cheaply-operated cupola furnace.

Mr. Arnott is undoubtedly correct in stating that it is necessary to have *about* 0.9 *per cent. of combined carbon with as low silicon as possible*. He points out that the actual percentage of silicon may be settled after consideration of the thickness and size of the casting. Whilst this is true, it is necessary to take into account, and into immediate account, that discovery has been made of, and a process worked out for, the production of castings containing 0.9 per cent. combined carbon with a much lower silicon than is possible under ordinary conditions. This invention, called the Perlit process, alters entirely the whole of our calculations and opens out possibilities of great magnitude, particularly as it has been proved that the content of combined carbon can be maintained at 0.8 and 0.9 per cent. or thereabouts in all the sections, and through each section, of the same casting; this even though there may be considerable difference of thickness between such sections. Mr. Arnott, as a metallurgist, will appreciate the value of the weapon now placed in our hands with which to fight the hitherto unsurmountable obstacles presented by this question of the grain and the combined carbon content of grey iron castings. All these are quite apart from the fact that the condition and distribution of the graphite is most favourably altered when the Perlit process is applied.

A remarkable contribution is that from Mr. Love, who says as follows:—

"When the foundryman can supply castings and cast iron which can be guaranteed to have a tensile strength not below, say, 10 tons per square inch in any part, there will then be some hope of uniformity in the thickness of metal used by designers."

Later on he alters his figure to 12 to 15 tons per square inch. I can assure Mr. Love that this is done every day in our foundries, and I am prepared to make him castings having a guaranteed tensile strength of 12 to 15 tons per square inch throughout all sections. I agree with him that the foundryman is wrong in supposing that the average Diesel engineer expects to get an intricate casting of special cast iron at the same price as an ordinary casting. On the other hand, it is not to be forgotten that the average foundry is incapable of making special cast iron, and, therefore, most unfortunately, the engineer, knowing this, is loath to raise his price so long as he has small hopes of obtaining anything other than ordinary cast iron.

Mr. Pearce also emphasises the desirability of obtaining pearlitic content, namely, 0.8 to 0.9 per cent. combined carbon. He is in error when he says it is not possible to get precisely similar irons for both liner and piston ring. It is true that this is difficult under ordinary foundry conditions, but I am positive there is no obstacle to doing it under those of the "Perlit" process.

There seems to be needless talk about Brinell hardness, as, in my own experience, this test for cast iron is exceedingly unreliable and, moreover, tells us nothing about the heat- and attrition-resisting properties of the metal. Much also is spoken about growth of cast iron at temperatures above 600 deg. C. I think it is reasonable to suggest that the growth of cast iron at any temperature is of importance to the matter under review. Those, who have had to do with the changes occurring in metals when raised to elevated temperatures, come against *the time factor* as being of supreme significant, and, therefore, if a ship goes to sea, for several years, with cast iron parts which, according to laboratory tests, do not grow at 400 deg. C., but which do grow at 500 deg. C. or 600 deg. C., there is no guarantee that the time factor will not come into play and bring about, at 400 deg. C., part or all of the growth which was observed only at 500 deg. C. or more.

I think it is extraordinary that the word "fatigue" has not entered into this discussiou (as published), for it is certain that fatigue tests of cast iron and impact-fatigue tests will have greater value in future practice than present-day tensile or transverse tests.

In speaking about cast iron tests, of all kinds, it is necessary to point out that, for the internal combustion engine in particular, no tests have any value unless the test bar is machined out of the thickness of the casting itself. It must have the same grain, micro-structure, physical properties and chemical composition as the casting. This is impossible to obtain unless the test bar has been part of the casting itself. Mass and thicknesses of section are the two things affecting the final condition of a casting made in any one particular manner of any one particular cast iron, and, therefore, it is imperative that the test bar shall be precisely the same as the casting. Test bars obtained in any other manner give no information whatsoever as to the suitability of the casting for service conditions, and are valueless.—Yours, etc.,

Horace J. Young, F.I.C.

16, Ashfield Grove, Whitley Bay,
April 24, 1925.

B.C.I.R.A. Associate Membership Grade.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—With reference to the letter in your issue of April 23 from Mr. F. A. Melmoth, the position of the associate member is indicated by the following paragraph in a leaflet on membership published by the Association:—

> Individual persons in the industry are permitted to join the Association as Associate Members, to receive the quarterly bulletin, and to make use of the library only, at a subscription of 30s. per annum. By becoming Associate Members, scientific workers, managers, foremen, pressmen, and others connected with the industry may link up with the Association.

Research associations in general are associations of manufacturers, since obviously manufacturing concerns are best able to bear the charges involved in conducting research work, and advances in knowledge can be put into operation by manufacturing establishments through the technical staff concerned.

The Cast Iron Research Association, however, does not distinguish, as far as membership is concerned, between the firm and the individual person to the disadvantage of the latter. The Council would be prepared to receive applications for full membership from any person engaged in the industry provided he is prepared to pay a subscription comparable with that received from other full members. In point of fact, many private firms, as distinct from limited liability companies, are members of the Association, and the membership in these cases is that of a private individual.

The question of privileges of the Associate Member is wholly financial. Clearly to distribute research reports to associate members is impracticable on the very limited annual subscription given above.

The Council is glad to have this opportunity of dealing with the misapprehension on which Mr. Melmoth's letter is based. With reference to the suggestion that the Association may be a menace to technical staffs, it should be said that the relations between the officers of the Association and members' representatives are cordial in the extreme, and the work of the Association is tending in precisely the opposite direction to the one suggested. The manufacturer is more readily recognising every year the necessity for adequate technical control and proper technical staffs. Technical staffs of non-members may, of course, feel that lack of participation in the work of the Association is a handicap.—Yours, etc.,

H. B. WEEKS,
April 25. Chairman of Council

The American Arbitration Bar.

Reply to British Comment by the Committee on Grey Iron Castings of the American Foundrymen's Association.

Adverse comment having appeared in the British "Foundry Trade Journal"* in discussion of the report issued at the A.F.A. Milwaukee Convention by the Committee on Grey Iron Castings, it is felt that some statement is desirable further clarifying the Committee's viewpoint.

The Committee believes that the British have read a great deal more into the report than was justified. There was nothing said in this report concerning the desirability of recommending the proposed 1.2-in. test bar as an international bar, the recommendation merely being what the Committee considered as an improvement over the old arbitration bar for American use. The discussion mentioned, however, would lead one to believe that the report was recommending an international bar.

The report also specifically stated that the bar was to be indicative only of the quality of the metal in the ladle. This last factor is one which we believe is mostly misunderstood by the British, and which, it is thought, is due to the difference in engineering practice in the two countries.

To understand the use of the arbitration bar in America one must remember that it is used for control purposes. The American engineer does not expect to find the metal in the casting giving the same physical properties as the metal in the bar. He does, however, know what quality of metal in the ladle, as represented by the arbitration bar, will give the desired qualities wanted in different castings, when the bars and castings are both grey iron. For special cases, as for chilled castings, chill tests, drop tests and special bars will probably always be desirable, and special specifications will be continued in use.

Mr. Shaw gives the impression that a certain size casting should always contain metal of a given strength and composition. His discussion is based on the adjustment of composition to check the possibility of having about the same results on the metal in all castings of different sections. While such requirements may be the rule in the British foundry industry, in America such a condition is not desired. It is because one may want hard, medium and soft iron in castings of about the same section that the American engineer believes that the uniform arbitration bar as a control medium is of the most advantage and most practical for use in this country. For instance, in the electrical industry, if one had to deal with three or four sections of test bars and yet had to produce the variety of castings that are required, one would become almost hopelyessly middled. Generator and motor frames are of very heavy section, yet for magnetic quality they must be made of very soft iron. At the other extreme in section is the resistance grid. This also must be soft, open iron when cast in a reasonable section, because a cross-section of the grid is so unreasonably small. Turbine housings are castings of very large physical dimensions, and not of particularly thick cross-sections, yet they must be made of a strong iron.

Because of such conditions which are found in most foundries in this country the American engineer feels that the arbitration bar for control purposes is preferable to the use of many different sized test bars to give direct quality tests. That there are arguments for the different sized test bars to represent the quality of the metal in the casting the American engineer admits, but he does not feel that the arbitration bar is masquerading under false pretences, for the American foundryman accepts it for what it is—a control agency and not a direct quality test. This, for his purposes, he feels to be the most practical.

For a direct quality test some such test as a Fremont test, advocated by the French, is considered to be theoretically best for determining the exact quality of the metal in any section of the casting.

Each country will undoubtedly have for national standards specifications which will not be desirable for international arbitration purposes. For an international bar engineering practices and needs in the various countries will have to be considered and some common ground for standards determined. This will take a great deal of study and a broad-minded viewpoint of the common needs.

As Major R. A. Bull stated in the exchange paper presented at the 1923 Manchester Conference of the I.B.F.: "There is much that each of us can learn from the other when mutual respect for genuine accomplishment exists." Such a state of mutual confidence and desire to co-operate is necessary if the foundrymen of the various countries are to work together to study the international test-bar needs, and finally to reach an agreement which is satisfactory to all.

* J. Shaw, "Foundry Trade Journal," Nov. 13, 1924. Editorial, "Foundry Trade Journal," Feb. 6, 1925.

"Lanz Perlit" Process.

A licence has been taken out by the North-Eastern Marine Engineering Company, Limited, of Wallsend-on-Tyne and Sunderland, for the working of the "Lanz Perlit" process (special pearlitic cast iron), after an exhaustive study of the subject on the Continent by their expert technical staff. A second licence has been concluded by Alfred Holt & Company, Limited, of Liverpool. Mr. John A. Smeeton, M.I.Mech.E., of 15, Victoria Street, London, S.W.1, is acting on behalf of the patentees.

XUM

Clerical Work in the Foundry.

By M. E. Nicholls.

In many of the smaller foundries (and in some of those which can be termed large) clerical work is treated as being of small account. The engagement of a clerk is looked upon as an unnecessary expense, and the "booking" is done by a foreman or a storeman—usually a man unskilled in the use of a pen, and who, as a consequence, holds "paper work" as a matter of minor import.

Some of the documents emanating from a foundry are weird and wonderful, but instead of exciting the interest of the recipient, they more often exasperate him. It would be thought that, whatever might be the attitude of the founder toward clerical work in the foundry itself, he would, in his own interests, ensure an intelligible document being sent to the customer, either as an advice or an invoice, but in very many cases the onus is placed upon the customer to render the document intelligible, and in this way the founder is often at the mercy of his customer in respect to payment.

CUSTOMERS' ORDERS.

Messrs. Brown, Jones, & Robinson, Ltd.

Date.	*Customer's Order No.*	*Qty.*	*Pattern Number.*	*Works Order Assigned.*	*Date completed.*
12/2/25	*1,376*	*100*	*KV/17/1*	*2,176*	
14/2/25	*1,397*	*50*	*MV15 1/*	*2,181*	
,,	,,	*50*	*MV/16/1*	*2,182*	
,,	,,	*100*	*KV/18/1*	*2,183*	
,,	,,	*50*	*MV/26/1*	*2,184*	

Fig. 1.

To give a typical example, a miscellaneous consignment of castings is forwarded to a customer, the consignment being accompanied by an advice note, purporting to give particulars of the castings included, and the weight. The latter is of the utmost importance, seeing that unfortunately payment is based upon weight, and not upon complication, but should the customer dispute the weight shown, the founder must accept the customer's figure.

WORKS ORDERS.

Works Order No.	*Customer's Order No.*	*Customer's Name.*	*Qty.*	*Pattern No.*	*Date completed.*
2,176	*1,376*	*Brown & Jones*	*100*	*KV/17/1*	
2,177	*C86*	*Blank Eng. Co*	*10*	*192*	
2,178	*A/1 1,166*	*Gray & White*	*30*	*17,767*	
2,179	,,	,,	*25*	*18,943*	
2,180	*161*	*Bold, Son & Co.*	*150*	*K187*	
2,181	*1,397*	*Brown & Jones.*	*50*	*MV/15/1*	
2,182	,,	,,	*50*	*MV/16/1*	
2,183	,,	,,	*100*	*KV/18/1*	
2,184	,,	,,	*50*	*MV/26/1*	

Fig. 2.

Why? Because the advice note gives the total weight of the consignment, and not the specific weights of the individual items. Even though a ridiculous system of a standard price rules for the whole of the castings involved, it will be found that the customer weighs the castings covered by each item separately (for the purposes of costing). As this is well known to the founder, there is no reason why he should not insert the weight against each item, so that should any dispute arise the item concerned can be instantly ascertained, and investigated.

STATEMENT.

From *Date, 14/2/25.*

Iron Foundry Co., Ltd., London.

To Messrs. Brown & Jones, Manchester.

Order No.	*Our Ref.*	*Qty.*	*Pattern Number*	*Metal.*	*Weight.*			*Ch'ck'd by*
					C.	*Qrs.*	*lbs.*	
1,351	*2139*	*10*	*KV/15/3*	*C1*	*2*	*1*	*17*	*SCV.*
,,	*2143*	*5*	*KV/17/1*	,,		*1*	*3*	*SCV.*
1,358	*2160*	*3*	*MV/14/1*	,,			*10*	*SCV.*
,,	*2161*	*50*	*MV/16/1*	,,	*1*	*2*	*1*	*SCV.*
,,	*2162*	*47*	*KV/15/1*	,,			*21*	*SCV.*

Received by.....

Fig. 3.

Failure on the part of the foundryman to quote order numbers, or maybe carelessness, which results in wrong order numbers being quoted, causes the customer a good deal of trouble and annoyance, and allied to this is the propensity to quote wrong pattern numbers. It may be that these latter are somewhat bewildering, for each customer has his own methods of numbering patterns, but this is no excuse for the founder omitting to furnish a correct and businesslike statement. The customer's order undoubtedly gives all the information required, and if reference is made to this, and the statements made out in accordance, inaccuracies will not appear. Not long ago the writer had a consignment of castings to check in, and owing to inaccuracies in regard to order numbers and pattern numbers the task occupied more than an hour, whereas if the statement had been accurate the checking could have been completed in fifteen minutes.

These troubles could be avoided were more attention paid to clerical work, and whilst it is not suggested that a large army of clerks be employed, it *is* suggested that every foundry should have adequate clerical assistance. The method employed need not be elaborate, but there must be *method*, and it is this attribute that seems to be lacking. As mentioned earlier, the customer's order gives all the necessary information, and if it is found to be impracticable to use the customer's order number and his pattern numbers for production purposes, the founder can make use of his own numbers provided that the customer's number can be identified. For example, in respect to order numbers, it may be that one customer is using a series 1,000 upwards, whilst another commences at 101. Sooner or later the numbers will clash, and then there is a likelihood of confusion. The foundryman can guard against this by assigning his own numbers, quoting the customer's number as a reference. The accompanying illustrations make this method clear, Fig. 1 showing the booking of the customer's order in its entirety, with the various works orders assigned to it, whilst Fig. 2 shows the works numbers in consecutive order, together with the customer's orders and pattern number assigned to each. This permits of easy reference, and does not entail a lot of clerical labour.

When a consignment of castings is ready for despatch, the works order numbers will furnish the clue as to destination, and a statement is made out for each customer giving all essential particulars as illustrated by Fig. 3. It will be noted that a separate works order number is assigned for each item, and when this is done there is little fear of any confusion or misunderstanding arising. A statement similar to the one suggested will be appreciated by any buyer of castings.

The Albion Steel Works, Briton Ferry, owned by the Briton Ferry Steel Company, Limited, closed down on Saturday last for an indefinite period.

The business of Hall, Lewis & Company, of Cardiff, etc., will shortly be floated as a public company with a share capital of £1,000,000. The new company will incorporate with the present business of railway wagon builders and repairers, coal and coke contractors, and iron and steel merchants, etc., which has over 80 works and branches all over the country, the Preston Wagon Company, Limited, of Preston, the Central Wagon Company, Limited, of Wigan, and Moy's Wagon Company, Limited, of Peterborough and London. These businesses last year made a profit of £116,390. The directorate will consist of the vendors, Mr David George Hall (chairman and joint managing director) and Mr. Samuel Harries Lewis (joint managing director), with Sir W. Charles Wright (chairman of Baldwins, Limited), Mr. Henry Gethin Lewis, Porthkerry (of Henry G. Lewis & Company, director of Baldwins, Limited, etc.), and Sir Thomas Williams (director of Baldwins, Limited). A public issue is to be made of £400,000 in 7½ per cent. cumulative preference shares, which is being underwritten, the 600,000 ordinary shares being subscribed by the vendors and directors. Hall, Lewis & Company are extending their Crown Wagon and Engineering Works at Maindy, where new machinery has been installed for the manufacture of wagons of the latest types, including 20-ton all-metal wagons to the specification of the Great Western Railway Company, and also for motor transport vehicles.

Gates and Risers.*

By F. C. Edwards.

Gates and risers may be placed in that category of things which one would gladly do without, but with which it pays to cultivate a very close acquaintance.

It pays—technically, as well as commercially. For although the mould itself may be perfect, and the metal composition and temperature everything that could be desired, it is by these factors—their design, number and location—that the production of good or bad castings is ultimately determined.

The function of the gate is to introduce the molten metal into the mould. To employ metal in gates, therefore, beyond that required for the fulfilment of this object is not economical; for re-melting entails expense and loss of metal. The riser facilitates the escape of gas from the mould, and takes charge of the dross. It may be regarded as an insurance. Here, again, where no risk is actually incurred, such insurance obviously spells unnecessary expense. It consequently follows—since, in selling castings, one cannot include the weight of those accompaniments of production—that the foundry in which they are cut down to the lowest efficient limits has a definite advantage over its less scientific competitors.

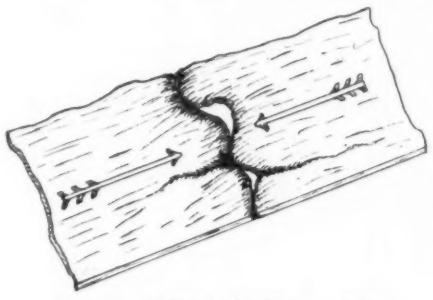


Fig. 1.—Misrun Caused by Bad Gating.

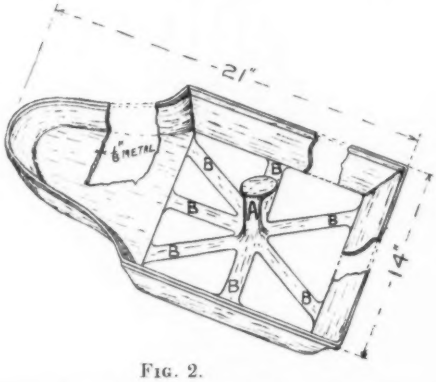


Fig. 2.

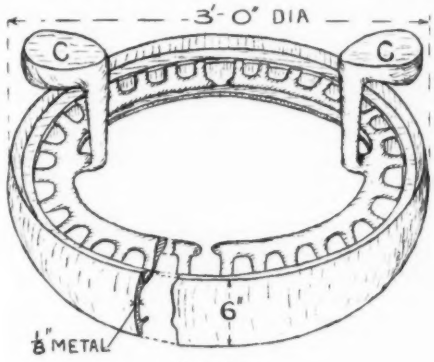


Fig. 3.

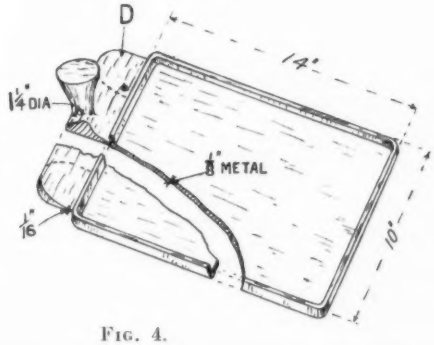


Fig. 4.

Now, while there are certain general principles which govern the efficient employment of gates and risers, their correct design is largely a question of individual consideration. Sometimes, indeed, a variety of methods have to be actually tried out before satisfactory results can be attained. A system of gating which is found to answer very well in one case may prove, in another, to be altogether inapplicable.

Hence the futility of such arguments as to whether this or that particular type of gate (considered by itself) is best, whether slow or quick running is preferable, or whether the riser makes for economy or is a wanton waste of metal. And hence, also, the reason why a large percentage of scrap can be definitely traced to improper gating. Such questions are not amenable to any stereotyped rule. Just as castings vary in weight and innumerable details of form, so must appropriate gating ever vary likewise. In short, every casting has its own peculiar gates.

Fundamental Principles.

Nevertheless, in gating a mould, one must always keep in view several common fundamentals. For instance, the outer orifice of the pouring gate should be situated above the level of the highest point of the mould. Otherwise the latter could not be filled with fluid metal. Generally, of course, this is completely assured by the addition of the gate box to the top of the cope. The pouring gate, again, should have a larger cross-section area than that of the ingate—or of the combined ingates. This ensures the pouring basin being kept full during the process of casting, and, by throttling the flood, allows time for the lighter scum to float to the top of the metal in the basin instead of passing into the mould; thus promoting clean metal. Incidentally, this explains how a reduction either in the number of individual area of the ingates often proves a successful remedy in the case of dirty castings—the dross has more time to escape.

It is also essential that the pouring gate—or gates (for the larger castings are poured from one or more widely-separated ladles)—should be so arranged as to deliver the metal to all parts of the mould at the same time. With light work especially, this is vital. Its neglect may lead to a "mis-run," or to the less obvious but equally fatal form of the latter, known as a "cold shut." It can easily be understood that when a thin stream of metal is made to traverse a large area of mould it quickly becomes chilled. Where two such streams meet there is a probability that the result will be similar to that shown in Fig. 1. Junction may taken place—but not coalescence.

Hence the extreme desirability of arranging the runner gates so as to restrict within narrow limits—depending, of course, upon the thickness of metal—the area of mould served by any single gate. A good example of this is illustrated in Fig. 2, which shows the gating of a grey-iron base of very light section.

* A Paper read before the Sheffield Branch of the Institute of British Foundrymen, Dr. Desch, F.R.S., presiding.

The job is poured from a central downgate (A), 1 in. in diameter. Seven spray gates or sprues (B) are so arranged as to conduct the metal immediately to all parts of the mould. The sprues are "knife-edged"—*i.e.*, at their junction with the casting they are less than $\frac{1}{16}$ in. thick. These fine apertures serve as strainers. They also enable the sprues to be neatly broken off without injuring the casting. Since all parts of the mould are simultaneously flooded with metal, it follows—with a uniform section—that cooling in every part commences at the same moment, and proceeds at the same rate. Uneven shrinkage stresses are thus obviated, and maximum efficiency secured from the metal employed.

A somewhat similar example is shown in Fig. 3. Here, again, the thickness of metal is but $\frac{1}{8}$ in. In this case, however, in order to furnish the requisite supply of hot metal to all parts of the mould, two downgates (C) are employed. The knife-edged sprues are also placed closer together than in the previous example. The pouring basin has a comparatively large area, which enables dross to be accommodated on the top of the metal in the basin instead of passing down into the mould. The job is poured simultaneously from two shanks—one at each side.

Downgates.

Downgates should be circular in cross section, as this form presents the least refrigerating surface for a given area. They will vary in diameter, of course, with the nature of the job; the greater the cooling surface of the mould relatively to the weight of the casting the larger must be the diameter of the gate. This point may be best illustrated, perhaps, by a comparison of two rather extreme cases, in which satisfactory results were only obtained after much careful experiment.

Fig. 4 represents a plate casting, 14 in. by 10 in. by $\frac{1}{8}$ in. in thickness, with a shallow rib round the outer edge. It will be noted that the sprue (D) extends across the full width of the plate. It is but $\frac{1}{16}$ in. in thickness at its junction with the casting. Two sprues, each about $2\frac{1}{2}$ in. wide, were, in the first place, tried with this job. These were placed at each side of the plate (as shown dotted). It was found, however, that the castings were more or less "channelled" from the sprue end to about half-way along the surface of the plate, on the bottom side, as moulded, and in a line with the centre of each sprue. Various experiments were made before a perfectly smooth surface was obtained. It was proved, by the way, that the evil was accentuated by hard ramming. The channelling was finally overcome by extending the sprue right across the plate, as shown. The weight of this plate is about 5 lbs., and the diameter of the gate at its juncture with the sprue is $1\frac{1}{2}$ in.

Comparing the above with the gating of a 56-lb. weight, as shown in Fig. 5. In this case a central ingate was first tried. This was abandoned later in favour of the two sprues E. There is here a cross gate (F)—which also serves as a skimming gate (which will be referred to later). The downgate is 1 in. in diameter. Thus a light plate weighing 5 lbs. requires a downgate of $1\frac{1}{4}$ in. in diameter (1.22 sq. in. area); whilst a compact block, ten times the weight of the plate, is poured from a downgate 1 in. diameter (0.78 sq. in. area).

Another point of interest is the way in which both these examples conform to a principle previously enunciated—namely, that the area of an ingate should be less than that of its respective pouring gate. In the case of the weight, each ingate, at its junction with the mould is $\frac{3}{8}$ in. wide by $\frac{7}{8}$ in. deep, which gives a combined ingate area of 0.65 sq. in., against a pouring gate area of 0.78 sq. in. The gating of the plate shows a still greater difference. The ingate, at its junction with the mould is 9 in. by $\frac{1}{16}$ in., an area of 0.56 sq. in.—or less than half that of the pouring gate, which is 1.22 sq. in.

It may be mentioned that these castings are made in large quantities, and must be definitely perfect. With the weights especially, the smallest pinhole leads to their rejection.

In heavy work downgates should be placed several inches from both the mould and the side of the box. It is also advisable to reinforce the mould around the gate so as to guard against the possibility of the metal breaking through the walls of the gate. For this purpose a tier of small box parts is sometimes rammed up in the mould with the gate pattern in the centre.

A better method, however—since it obviates the risk of the mould peeling away from the flat walls of the small box parts, and facilitates the escape of gas—is to ram up the downgate pattern in the centre of rough cast-iron prodded rings, say, 6 or 7 in. in diameter, as shown in Fig. 6. The larger space between the prods at G enables the ring to be placed over the ingate core, to which it affords a certain support. These rings are built up, one above the other, to suit the height of the job.

Yet another, and still more reliable, method is to employ sleeves of loam cores. For instance, if the gate is to be, say, $1\frac{1}{2}$ in. in diameter, the core would be spun up on a barrel 1 in. in diameter, over a thin layer of hay band. When dry the core is sawn round into, say, 12-in. lengths and slipped off the barrel. These sleeve

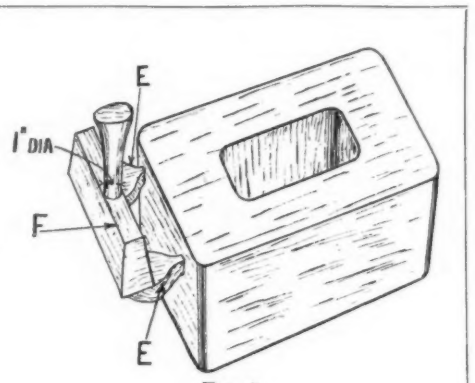


Fig. 5.

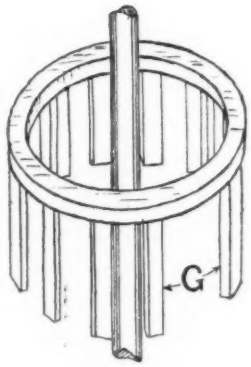


Fig. 6.

cores are rammed up inside the prodded rings (Fig. 6). The gate stick is not then required. Whilst ramming up each sleeve, however, the moulder plugs the top of the hole with hemp or cotton waste to keep sand out of the gate. Arrangements are made, of course, to lead the metal into the mould through channels formed in separate cores. To prevent the falling metal from digging up the bottom of the gate a blacked brick is sometimes employed. In the case of moulds for heavy steel castings, firebrick gates are employed.

The necessity for the above precautionary measures can be realised when it is remembered: (1) That the downgate is subjected to higher temperature metal than any other part of the mould; (2) the high temperature is continuously maintained as long as pouring lasts—*i.e.*, during the passage through the gate of (in some cases) several tons of metal; (3) there is more risk of attrition here consequent upon the violent motion of the falling metal; (4) an internal pressure is set up owing to the throttling of the stream at the ingate, and, to some slight extent, to the head of metal. Among other things there is always a possibility of the metal bursting through the joint

of the box. This is known as a "run-out." Should this occur, though it may be promptly arrested, sufficient time may have elapsed to produce solidification of the sprues before the mould is filled—and the result is a "mis-run."

Impact effect of Metal on Mould.

A prolific source of scrap is that arising from the under-estimation of the impact effect on the mould, or cores, of the incoming stream of metal. This impact effect is greatest, of course, in the case of direct running. And, in order to obviate scabbing, the careful moulder will see to it that the region of the mould upon which the falling metal impinges is well studded with sprigs or otherwise reinforced. There are moulds, however, such as those for fine fluted plates, where sprigs cannot be used. In such cases scabbing can be prevented by using more than the usual amount of coal dust in the facing sand, and giving greater attention to venting. Here the old maxim that "one vent is worth a dozen sprigs" is peculiarly applicable.

Similarly with regard to cores. These should be made so that the risk of washing or displacement by the incoming metal is reduced to a minimum. Moreover, it is sometimes necessary to lead the metal through one or more of the cores in the mould. For these and other reasons efficient gating calls for the closest collaboration between

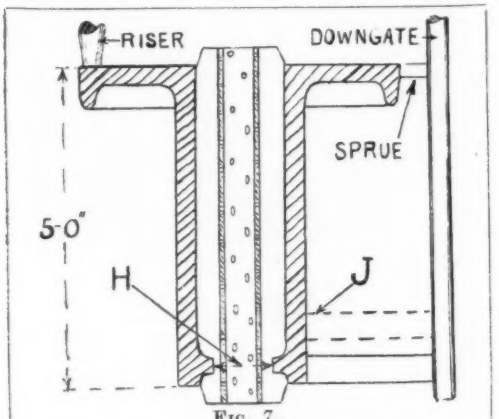


Fig. 7.

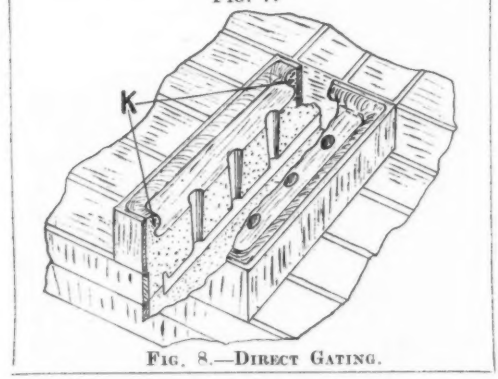


Fig. 8.—Direct Gating.

moulder and coremaker. Obviously, the coremaker can render the best service only if he is perfectly clear as to the line which the moulder intends to take on any given job.

It may here be of interest to refer to an actual case in point, where an inadvertent lack of the above-mentioned co-operation produced, among other things, one of those well-known pyrotechnic displays which usually follows when molten metal finds its way into a core barrel.

Briefly, the mould for a cast-iron flanged pillar, 5 ft. high and 9 in. in diameter (shown in Fig. 7), was being poured. Just as the appearance of the metal in the riser indicated that the mould was full an explosion took place. Molten metal shot upwards from the core barrel to the foundry roof. The heavily-weighted cope was distinctly seen to heave up at one side. Fortunately, however, for those standing around it immediately recovered its equilibrium.

Strange to say, when the casting was stripped it was found to have suffered no permanent ill-effects from its stormy birth. Subsequent inquiry proved pretty conclusively that the cause of the explosion was as follows:—

(1) On account of the comparatively small diameter of the neck (H) at the bottom of the core, and the need for employing a strong core barrel the loam here was necessarily very thin. (2) The moulder had inadvertently placed the ingate so that the incoming metal was led directly on to this weak neck. As a consequence the continuously impinging molten metal upon this part gradually wore away the loam. The hay band would immediately be consumed, and the entry of the molten metal through the vent holes into the core barrel would inevitably follow.

The core barrel was found firmly attached to the neck of the casting, and some of the hay band had been converted into beautiful cast-iron spirals. Subsequent castings were gated a little higher up the core, as at J, where the loam was thicker, and, therefore, better able to withstand the impact of the incoming metal. The coremaker also employed string instead of hay band at this neck, thus allowing for more loam.

Direct Gating.

With shallow work—such as plates of large area—direct gating is found to give the best results. Fig. 8 represents a section through the gate box for casting a plate 8 ft. by 9 ft., and ¾-in. in thickness, with ¾-in. deep chequering on the bottom side, as moulded. It will be seen that six downgates, each ¾-in., are employed to run this plate. In order to obviate washing, the mould, directly under each downgate, is well studded with sprigs. As the metal is literally thrown from the ladle into the pouring basin (so as to run the job as quickly as possible), the basin is formed with overhanging lips (K), which prevent the overflow of the metal. In order to ensure clean castings, "run-offs" (not shown) are resorted to—one at each corner of the plate. A "run-off," it may be observed, is a form of riser whose outer orifice (contrary to the general rule) is below that of the pouring gate. Each run-off aperture is stoppered, *i.e.*, sealed with a brick, until the mould is filled with metal. The brick is then removed, and from 2 to 3 cwt. of metal allowed to escape. In this way stray scum—besides that collected by the metal as it passes over the mould—is eliminated. At the junction of each gate with the mould a small fillet is formed, which prevents the gate from "breaking into" the casting as it is being knocked off.

Combined Top and Bottom Gating.

For many kinds of deep work a combination of top and bottom gating is advisable. Figs. 9 and 10 show plan and side elevation respectively of a case in point. The casting is 11 ft. long, 4 ft. wide, and 3 ft. deep. It is cored out to leave internal ribs and bosses (not shown). The general thickness of metal is 1 in. All external faces are machined. It will be seen from Fig. 9 that bottom and top downgates (L and M respectively) are employed at each side of the job. The gates are "broken" on the cope joint (Fig. 10) to reduce the depth of the fall. In order to exclude the scum from the mould all gates are stoppered at the commencement of pouring. Two kinds of stoppers are shown—the plug (N) and the block (O). The removal of the block is not so likely to disturb the sand at the top of the gate as is the withdrawal of the plug; though it offers, of course, greater resistance to removal on account of its larger area. The stoppers are well blacked and dried before using, to shield them from the action of the molten metal to which they are exposed. Fusible stoppers are sometimes used. The block of tin, for instance (melting point 232 deg. C., exposed to molten cast iron, say, at 1,330 deg. C.), prevents the metal from entering the gate a sufficient length of time before melting away to enable the basin to be well filled.

The job is poured as follows:—When the pouring basin is nearly filled, plugs N are withdrawn to allow the metal to enter the downgates L. From thence it flows through bottom ingates, P, into the mould. When the mould is judged to be about three-parts filled with metal stoppers O are removed. This admits the metal to down-

XUM

gate M, and thence to the top of ingates Q. This fresh stream of hot metal breaks up the crust on the top of the metal rising in the mould and prevents lodgment of dross near the top of the job.

In the above example ingates P and Q were formed by cores, this method being safer than

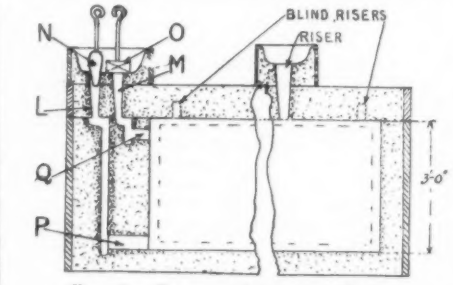


Fig. 9.—Plan of Gates and Risers.

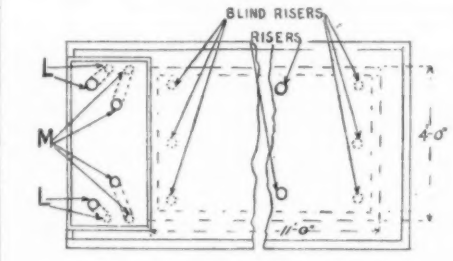


Fig. 10.—Side Elevation of Fig. 9.

that of ramming up tapered gate plugs and withdrawing after the pattern is removed. Two risers were employed over heavy sections in the centre of the job, and three "blind" risers, 3 in. high, formed at each end to take care of the scum.

Tangential Gating.

With cylindrical work it is generally the best

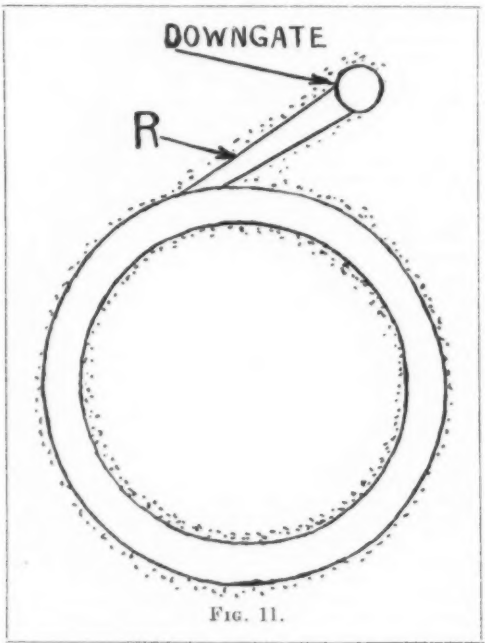


Fig. 11.

practice to introduce the metal at a tangent to the circumference. The ingate is then arranged as at R, Fig. 11. This method has at least two advantages over that where the metal impinges directly on a core. There is less risk of mould disturbance, and, if there is any dross present, it is not so likely to become attached to the sides of the mould, but is carried upwards by the swirling motion of the metal.

(To be continued.)

The Works Manager and the Foundry.

By J. D.

How far is it safe for a works manager to interfere in the management of a foundry? The question is an absorbing one. The writer has in mind a foundry which for years was run satisfactorily by a foreman, then a change of the organisation was decided upon, the foreman was reduced to the position of a charge hand and the works manager assumed active control; that is, he purchased material, decided on policy, and did everything except the actual practical supervision of moulding and casting. The sequel to this course was that, in about twelve months time, the firm decided that the foundry was unprofitable, and closed it down. Since then they have purchased castings from outside, although the plant—it was a well-equipped foundry—has been allowed to stand.

The works manager is generally wise to leave the management of the foundry in the hands of a capable moulder. He may not know much about the practical side of foundry work, may indeed have a difficulty when walking past a dissembled mould in deciding which parts are mould and which are cores, but results will soon enlighten him as to the abilities of the foreman. The trouble often is, of course, that works managers who have no practical experience of the foundry often judge it in the same way as they do the fitting and machine shops. They fail to realise that there is always an element of uncertainty in foundry work, and that it is quite impossible to eliminate "wasters" entirely. Any experienced man knows, also, that a foundry may have a run of success for months with few "wasters," and will then strike a bad patch. The works manager does not always allow for these things, and a very capable foundryman may be blamed for results, which, however annoying and costly, it may not be fair to attribute to him personally.

On the whole, it is better that works managers should take an interest in the foundry's work. A manager who has a knowledge of moulding may be a critic, but he has a sympathetic understanding that the other man lacks. It is probably true that the backwardness of the foundry for many years was due to the fact that engineers took no interest in it; castings were simply necessary things produced in a dirty shop. The foundry was not recognised as it is to-day as a most interesting department presenting complex metallurgical problems. The position has greatly changed, as is evidenced by the number of papers on foundry topics that are presented to purely engineering technical bodies and to the "fraternisation" which exists between engineers and foundrymen.

The works manager has a right to demand that work in his foundry shall be done at a competitive price, but it is wrong for him to say whether work should be hand or machine moulded or made in loam, drysand or greensand.

Works managers should, undoubtedly, leave the purchase of material largely to the foreman moulder. The writer recollects an instance of a foundry foreman being over-ruled and a huge quantity of sand being purchased which resulted in bad work and was a general nuisance for a long time. The foreman moulder ought, also, to have the final say about the installation of new equipment, whether moulding machinery or melting plant. An engineer may be more competent to criticise mechanical details, but not to appraise a moulding machine as a production unit.

There are works managers who never enter the foundry, and who depend absolutely on the foreman. This is surely the wise course to adopt when an understanding of the fundamentals of foundry practice is lacking. It is regrettable that so few engineer apprentices go into the foundry. They usually spend three or four years between pattern-shop, fitting shop and machine shop before finally going into the drawing office. Yet a year spent in the foundry—which is missed because of the disagreeable conditions—would give them invaluable knowledge, and those that ultimately occupy responsible managerial positions would be better fitted to obtain the maximum efficiency from the foundry.

Castings for Machine Tools.*

By H. Jowett.

(*Continued from page* 344.)

Cheek for Milling Machine.

Fig. 15 shows the top part and the pattern, which illustrates the depth of the foot (3 ft. 2 in.). The bottom part of the mould was cast green-sand, but the top was dried, as it is advisable when the number of chaplet stalks that have to be fastened are considered. They numbered seventeen in all, as there are two loose cores, in addition to the

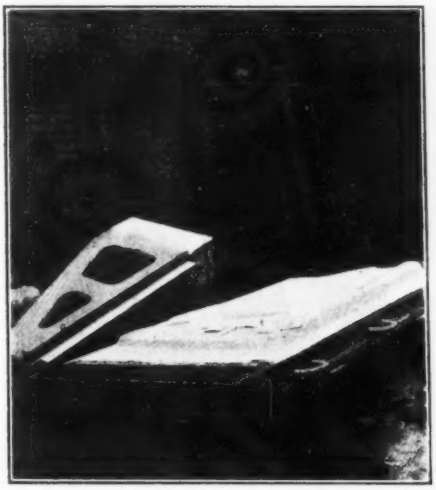


Fig. 15.

body core, to be held down. The chaplets are wedged under bars that are across the moulding box. Weights are placed on the bars to hold the box from lifting. Fig. 16 shows the finished casting, two of which are required for the actual machine. The flange on the side of the casting, as shown, was dovetailed on to the pattern, to allow the moulders to draw forward after the pattern had been withdrawn. The circular holes on the

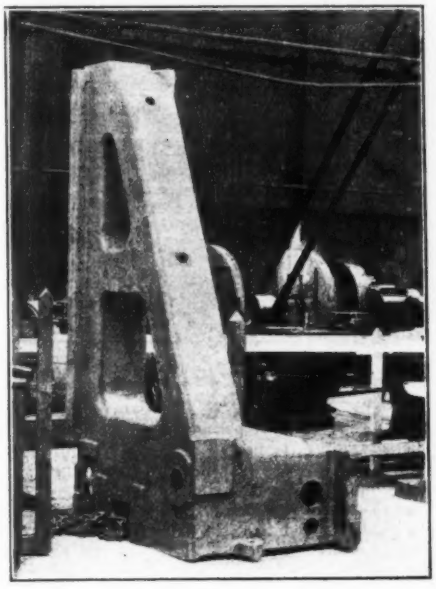


Fig. 16.

side of casting are those referred to as being necessary for getting the gas away from the main core. The two holes against the flange were the only outlets, except for the holes opposite. This core is 20 in. deep, 13 in. wide, and 18 in. in breadth, and was made in oil sand, as also were the cores on the side of the slide. The opposite core was 2 ft. 5 in. by 22 in. by 18 in., and is rather deeper. The weight of the casting is 36 cwt.

Cross Slide Head.

Fig. 17 illustrates a head that is fixed on a cross slide. This pattern is of rather peculiar design from a moulder's standpoint, especially when it is realised there is no moulding box to turn or roll over in a top and bottom box part. This makes it worse to bed-in, owing to the vee-shaped appearance at the entire bottom of the pattern. The depth of this pattern is 4 ft. 2 in., the length 6 ft. 1 in., and the width 3 ft. 10 in. It was bedded-in the floor and rammed to the top of the tapered part, then lifted out and the surface made hard and vented. It was finished off, as it is undoubtedly very awkward to finish if it is left over until the pattern has been rammed up to the joint, because, underneath it, the slide-part has to have a layer of ashes fixed for taking gas away

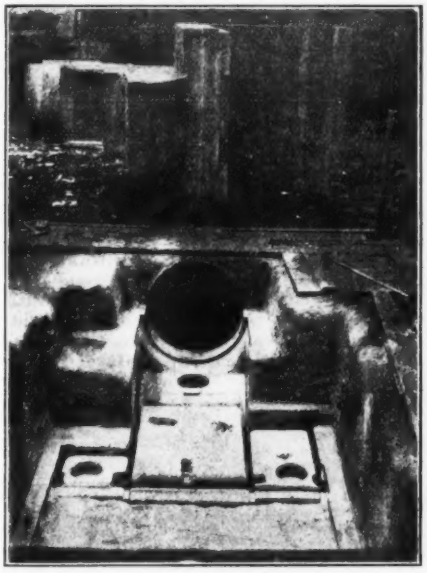


Fig. 17.

from the cores at the side. However, by finishing the bottom first, the moulder gained the advantage of room, and it was better for him to fix the bearings under the core-prints. The half-round core in the illustration is not in position in the centre of mould, but Fig. 18 shows that part with the core in position, and illustrates the top half of the mould. The top box is 8 ft. sq., 9 in. deep, and is a fast-barred box. The lift was 26 in., and grids were made to save lifters being used, as the author insists that a grid is far better if packings are rammed on the top of it and are wedged underneath the box-bar. They can then be hooked and bolted to the top of the box. If they are screwed up tightly, it is then impossible for them to give or overhang. At the front of Fig. 18 are a few of the core boxes, which formed the cores shown fixed in the mould in Fig. 17. The chaplet stalks are fixed in the top half, to prevent the cores from lifting. The bottom part of this mould was cast green-sand, but the top was dried. The weight of the finished casting was 29 cwt.

Plano-Milling Machine.

Fig. 19 illustrates the mould for a cross slide for a plano-milling machine, the length being 13 ft., the width 25 in., and the depth 18 in. It is flanged on each side of the mould and underneath

* A Paper read before the Burnley Section of the Institute of British Foundrymen, Mr. G. Barnes presiding.

the flanges there are slides 3 in. sq. the full length of the casting. The mould is cored up ready for the top part being lowered in position. There is a lift in the top part of 10 in. The size of the cores under the ones shown are 17 in. wide, 5 in. deep. They are bracketed round the corners for strength, and the gas is sent into the coke bed. The cores shown are placed on 1¼-in. double studs, this being the thickness of the flange on each side of the mould. All round the cores there was a

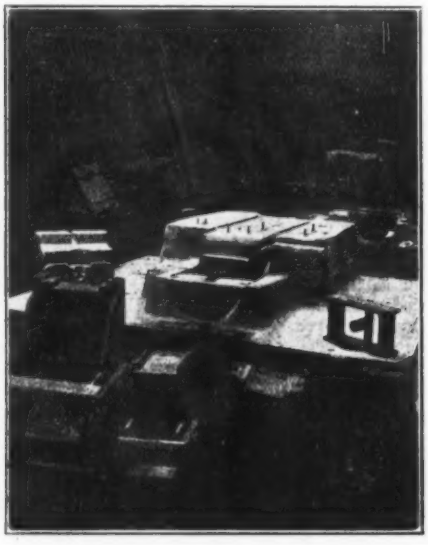


Fig. 18.

thickness 1¼ in., except where the 7-in. diameter core is shown. This latter cuts through on the top, the air coming away from tubes rammed through the top part after being lowered in position. The plates, ⅛ in. thick, are galvanised, and a ⅝-in. iron stalk in the top part rests on the centre of the plate to hold the core in position. It is wedged under the weights on the moulding box to prevent them from lifting. These cores are 2 ft. 6 in. long, 18 in. wide, 10 in. deep, and

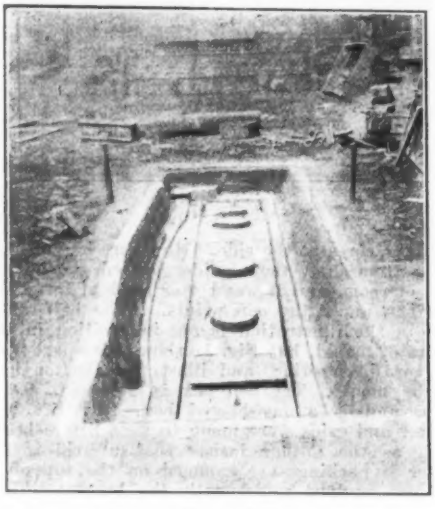


Fig. 19.

are all made in oil sand, which gives a harder core and saves dressing. The weight of this casting was 39 cwt.

Bed for a Plano-Milling Machine.

Fig. 20 illustrates the making of a bed for a plano-milling machine. The length of this mould is 26 ft. 6 in., 5 ft. 3 in. wide, and 2 ft. 3 in. deep; whilst the pattern was only 14 ft. long, it entailed double work for the foundryman. In the first place, it is necessary to level a bed for the whole length of the mould, and allow the amount of camber required, which was ⅝ in. in this case. The pattern was put on the bed, rammed up and withdrawn. Two wings were fixed on each side of the pattern, and then the pattern was put on bed again, checked for length, and rammed up again. The outside slides on the bottom are 9 in. wide, 4 in. thick, and on the inside are 7 in. wide, 3½ in. thick. The small oblong cores are oil wells on the slide. The wing cores on the side are 4 ft. 4 in. long, 16 in. deep, and 7 in. wide, and

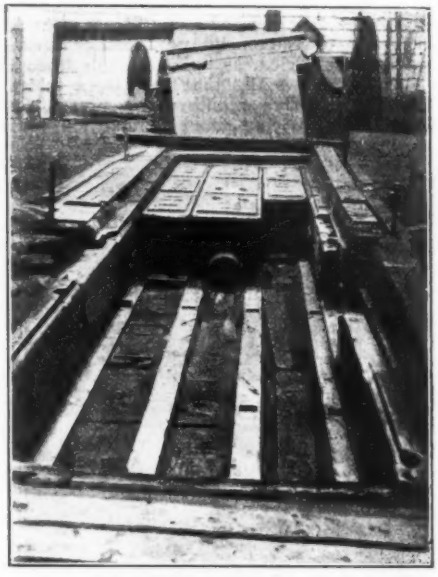


Fig. 20.

are bolted back and then wedged on the inside to main cores with double studs and chaplets on the top. Underneath the cores there was only 2 in. of sand, which was very awkward for ironing, and good, long, loose irons had to be used both ways to stop the sand from washing. Round the sides of this mould a layer of small ashes was laid about the centre, to help to get the gas away better. Four runners were placed about 2 in. from the bottom of the mould, 5 in. long, 1 in. thick, with down runners to correspond. At the other end of the mould there were two similar runners 15 in. from the bottom of mould. The reason for runners being in these positions was

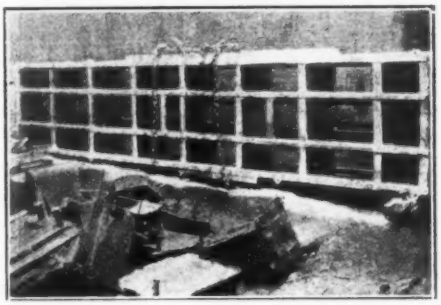


Fig. 21.

to allow for one ladle to get a certain amount of metal in the mould before the other ladle commenced to pour. If both runners were put at the bottom, it would involve both ladles commencing to pour mould simultaneously. This would have put more strain on mould. Fig. 20 shows the mould partly cored up; the thickness of metal on the outside was 1 in., and ⅞ in. was the thickness of the centre bars, which were flanged all round the top of the cores. The arch core also has a 1-in. flange, 4 in. broad, on every section of core. Slot cores 14 in. by 12 in. by 3 in. were fixed in prints to allow for flanges on the bottom of mould. The air from these cores was led out through the top box, whilst tubes were rammed up to prevent metal from getting into the vent. Two top parts, 20 ft. by 8 ft., and 10 ft. by 8 ft. by 9 in. deep, covered this mould. The bottom part of mould

was made in green-sand, but the top part was dried. Fig. 21 shows a full view of the casting in the dressing shop; its weight was 10 tons 15 cwt., and it was practically straight. In conclusion, the author would like to express his sincere thanks to his employers, Messrs. John Holroyd & Company, Limited, Machine Tool Makers, Milnrow, for assistance given, and especially in the preparation of the illustrations.

DISCUSSION.

Mr. J. Hogg said one of the lantern slides showed the bed for a Plano milling machine, the length of the mould being 26 ft. 6 in. He observed that while the top part was cast in dry sand the bottom part was in green sand. That led him to wonder to what lengths Mr. Jowett would go in casting in green sand, because he recollected that Professor Rhead, at Manchester, some years ago, stated that green sand moulding was the cheapest if it could be carried out successfully. Obviously Mr. Jowett's experience was that he could do it successfully, so it was no use to put it to him that it was better to use dry sand for these heavy jobs. In certain parts of Yorkshire, where they had many castings of this nature, green sand was used, and the practice had evidently extended to Rochdale, but he had not observed that foundrymen elsewhere were prepared to go to the same extent. Perhaps Mr. Jowett would explain his reason for adopting the practice. Was it because it was the cheapest method, or was it because he had confidence in his ability to do it successfully?

Mr. Jowett had mentioned that the amount of camber required in this case was $\frac{3}{8}$ in., and it came out correct within $\frac{1}{4}$ in. His own experience was that there was no hard and fast rule for camber, whether side camber or bottom camber, and he thought there were foundrymen who had had to make these big castings and who would agree with him on that. But Mr. Jowett had certainly solved the problem very nicely.

One very significant remark deserved to be emphasised. Mr. Jowett said before he started on a certain job he looked at the structure of the casting. That was very necessary. The structure had much association with the camber.

Then there was the statement that in many of these jobs the draughtsman did not allow enough machining to the foundrymen. He quite agreed that there was not enough machining allowed to enable them to get the beautiful highly-finished castings which the engineer demanded to-day. Nothing had been said about test bars in the casting of these jobs. Perhaps Mr. Jowett would say what he considered to be a fair tensile or transverse test in such cases.

Mr. Jowett replied that green sand was the cheapest. It was used in the Yorkshire district for castings weighing as much as 30 tons. It was a question of training. Having been trained to it one naturally adopted it. They got a good skin for the green sand castings. Two jobs, an internal grinder and an external grinder, were so cast, and were very favourably reported upon. Camber, on odd occasions, they did not get quite correctly. It was only fair to say that. But, taking the number that they made of different design, he thought they were successful.

They had test bars on some jobs that were coming along now. Usually they had 28 to 30 cwt. on a transverse test, and sometimes as much as 32 cwt. The bars were 14 in. long. They generally used Glazebrook, hematite and Thornhill. All the pig-iron was tested by a laboratory chemist before it went into the furnace. They had tried semi-steel, but it was never a success.

Mr. McVie observed that he had got 33 and 34 cwt. on a 1-in. bar.

Mr. Wilson said he was told by the chemist that 30 cwt. was obtained on a bar 1 by 1, 12-in. centres.

Mr. J. Pell said the foundries in the Burnley district were mainly concerned with textile machinery work, and did not make jobs similar to those Mr. Jowett had described. Possibly for that reason the discussion would be restricted. There were certain jobs in the engineering line, such as valves for pumps, etc., which could be cast in green sand, if one chose to do so, but for which he should prefer to adopt dry sand as being far safer. The extra cost of drying it was small. Another point which attracted his attention was the facing sand. There must be a special class of facing sand with many sprigs, and a special preparation of the face of the mould, particularly where the runners were. Much depended on the temperature at which the metal was poured in. It was liable to burn the sand and cause a collapse. That was due to the sand not being sufficiently refractory. He would like Mr. Jowett to give the mixing of the sand he used for heavy castings in green sand.

Facing Sands.

Mr. Jowett said for facing sand they used a mixture of three barrows of black sand, one barrow of red sand, and one bucket of coal dust. It gave a very porous sand. Sprigs were placed practically flush with the metal where there was any real weight of metal and up the sides as well. The core sand was composed of:—8 parts of black sand, 4 of red sand, 2 of manure, and 2 of coal dust. He also used manure in the ordinary facing sand, using about a bucket where there was a good thickness of metal. For loam sand he used a mixture of 8 parts of red sand, 2 of manure, 2 of coal dust, and 1 of sea sand. For small shops he used a yellow refractory sand. They always ordered No. 1 or No. 2 yellow sand. The mixture was one barrow of yellow sand with one barrow of superfine coal dust and one spade of ornamental blacking. They obtained a very good skin on their castings. They did not dry the small ones.

Mr. Pell asked for information as to Mr. Jowett's practice in the use of oil-sand cores.

Mr. Jowett stated he put ashes in oil-sand cores. The heaviest core he had made was 8½ cwt.

A vote of thanks was accorded the lecturer.

Foundry Trades' Equipment and Suppliers' Association.

The 29 firms which have become members of the above Association are:—The Adaptable Moulding Machine Company, Birmingham; The Atlas Preservative Company, Limited, London; August's Muffled Furnaces, Limited, Halifax; Beecroft & Partners, Limited, Sheffield; The Blackfriars Foundry Requisite and Equipment Company, London; Britannia Foundry Company, Limited, Coventry; British & Continental Traders, Limited, London; Celtic Collieries, Limited, Cardiff; The Constructional Engineering Company, Limited, Birmingham; W. Cumming & Company, Limited, Glasgow; "The Foundry Trade Journal," London; Fordath Engineering Company, Limited, West Bromwich; Foundry Plant and Machinery, Limited, Glasgow; The General Refractories Company, Limited, Sheffield; Arthur L. Gibson, Twickenham; Grandidge & Mansergh, Limited, Manchester; George Green & Company, Keighley; Charles Hall & Company, Manchester; Lewis Hall & Company, Cardiff; International Processes, Limited, London; James Keith & Blackman Company, Limited, London; Lawson Walton & Company, Limited, Newcastle-on-Tyne; Marley Hill Chemical Company, Limited, Newcastle-on-Tyne; H. G. Sommerfield, London; Spermolin, Limited, Halifax; Stella Gill Coke & By-Products Company, Limited, London; Sterling Foundry Specialities, Limited, London; E. Tallis, Birmingham; Universal System of Machine Moulding Company, Limited, London.

Contracts Open.

Glasgow, May 5.—Materials, etc., for the Corporation:—Brake blocks (chilled iron); castings (iron); castings (malleable); castings (steel); iron and steel bars, plates, etc. Mr. J. Dalrymple, general manager, 46, Bath Street.

Cleethorpes, Lincs., May 9.—800 yards of iron unclimbable fencing, for the Urban District Council. Mr. L. W. Pye, surveyor, Council Offices, Cleethorpes.

Leicester, May 9.—Supply of cast-iron pipes, bends, branches, special castings and sluice valves for rising mains and for other ironwork in connection with sewage disposal works, for the Corporation: Section A, cast-iron pipes; section B, cast-iron pipe specials; section C, sluice valves, wall penstocks, floating arms, etc.; section D, automatic revolving sewage distributors. Mr. E. G. Mawbey, city engineer and surveyor, Town Hall, Leicester. (Fee, £2, returnable.)

Economics in Core Production.

By "Celsian."

The successful working of a foundry is influenced to a large extent by the location and equipment of the core department. As a large amount of raw material is employed in this department it is advisable, when designing a foundry, to reserve a place for it as near a railway siding as possible. The main object in planning the lay-out of a core room is to secure a "straight line flow." The advantages of this arrangement are too often overlooked, and consequently much valuable time is lost. As the process is a definite one, no trouble should be experienced in securing an easy flow of sand from sand storage to batch mixer and straight through the operations in the core room to the foundry. In several large works the core department is constructed and equipped with mechanical appliances so that there will be a continuous movement of material right across the building through all the various stages of the process in regular succession. The finished cores are then conveyed by the shortest possible transport to the foundry.

When it is proposed to construct a new lay-out in an old building, the problem should be studied and an efficient scheme evolved whereby the best results will accrue from existing conditions. In order to secure this, several factors require consideration, viz., the size and strength of the cores to be manufactured, the number of pounds of cores to be used per moulder, the distance between the core-room and the exact moulding centre.

Hauling the cores long distances or repeatedly handling them results in frequent loss. Breakages can be greatly reduced when transport over free gangways or overhead conveyers are used. The disorder and waste resulting from the employment of narrow gangways, and the practice of allowing work to pass to and fro along the same route, are subjects to be deprecated. Nevertheless much can be done to minimise the cost of production in a small shop having no mechanical appliances.

Raw materials and products should be studied and efficiently handled, thereby securing the most satisfactory results. The continuous manufacture of uniform products can be accomplished by using dry sand, therefore manufacturers should not purchase sand of varying moisture, but continue to buy one which has been proved to contain the least possible moisture. Dry sand has the advantage of occupying less space than moist sand. As is well-known dry sand increases considerably in volume when wetted. Various expedients are sometimes employed to dry out sand, amongst them being that of introducing heating coils under the sand-room floor. Occasionally small sand heating stoves are installed with varying degrees of success.

After being mixed, the core sand is either taken directly to the core room or shovelled into bins. Much time is lost when those bins are constructed in such a manner that the sand has to be scooped out from the top. When bins of this description are installed they should have sliding or lifting doors at the bottom to enable the workers to shovel the sand from the floor. It is not always necessary to use new sand in making cores, since great saving can often be accomplished by the use of old sands and binders.

Experiments have proved that by the employment of varied mixtures, such as gangway sand, lake sand and glutin, equally strong cores can be made at one half the cost of those made with new sand. A compounding mill in the core room proves economical, as it is instrumental in using large quantities of gangway and old core sands. A stronger mixture is obtained by its use than when mixing by hand with new sand.

In order to obviate the loss of time inevitably incurred by the irregular treatment of materials, and the use of varying measures, it is advisable to standardise materials and methods of working. By using standardised cups, boxes, buckets, barrows, and riddling and mixing machines, a mixture can be standardised effectively. Much trouble would be prevented if instructions were issued to the workers in printed form instead of the common practice of giving oral directions, which are often misunderstood and sometimes forgotten altogether. Printed instructions could only be carried out in a core room equipped with standard measures.

If sand with varying proportions of moisture is used, working core sand in the boxes is a troublesome matter, on account of its adhesive nature, resulting in the mixture proving unsatisfactory when baked. It will then be either too dry, too hard, or not sufficiently strong. Workers can turn out a greator proportion of cores when using a free working material than when they employ binders which have a tendency to adhere to the core box. In many cases the adhesion is due to the employment of a larger percentage of binder than is actually necessary, consequently by adding less binder the trouble can often be prevented. Racks should be always conveniently placed, preferably at the back of the core-maker's bench. If this arrangement is carried out a core-maker can place the finished cores on a rack without moving away from his bench. Immediately a rack is filled it should be removed to the oven by an unskilled worker, and another empty rack placed in its stead. Otherwise much valuable time will be lost by the core-maker's unavoidably numerous journeys to and from the oven, not to mention his having to secure an empty rack before resuming work at his bench. Wherever possible mechanical control of the oven should be installed, since it is necessary to keep the temperature uniform. There should be little difficulty in determining the best temperature and time required for the rapid and, at the same time, thorough baking throughout a uniform mixture.

Arrangements to facilitate pasting and dipping should not be overlooked. Pots holding paste and black wash should be set into the bench in such a manner as will not interfere with the work and yet always be at hand ready for use. When finished, the assembled cores should be taken to the care-storage if not immediately required in the foundry.

When left lying about on insecure or faultily constructed trays or platforms they are often exposed to much ill-usage.

Great loss is experienced in foundries on account of the careless handling of cores. Some workers seem to have a peculiar antipathy to economy in any form, and are apparently quite oblivious of the fact that broken cores mean monetary loss.

In order to eliminate the necessity of storing in trays and carrying or hauling cores from one stage of the process to another during operations, several foundries have instituted a method of progressive finishing in the core department. By this method the benches are so arranged that the different operations can be performed in regular succession by the workers whilst sitting side by side or tête-à-tête across the benches. This arrangement enables the workers to pass the cores from one to another, thereby effecting a reduction in breakages.

In large shops, where many tons of sand are worked per day, the installation of extensive equipment is indispensable. Where the output is small it proves remunerative to handle the core sand from stock bins to mixer and core benches in wheelbarrows, provided the core maker works uninterruptedly at his bench. Whilst the installation of extensive equipment might reduce immediate cost of handling, all-round expenses would probably prove heavier than when carrying out operations by hand.

John A. Smeeton, Limited, 15, Victoria Street, Westminster, London, S.W.1, have been appointed the sole agents for the Demag Company as regards all rolling mill and other similar plant, and T. Fearnley Allen, of 67, Norwich Union Chambers, Birmingham, is acting on Messrs. Smeeton's behalf in the Midland area.

The new firm, Delco-Remy & Hyatt, Limited, held their annual staff dinner at the Holborn Restaurant, this being the first gathering of its kind since the amalgamation of Delco-Remy, Limited, and Hyatt, Limited, which took place in October last. In the course of the evening it was stated that the company had now acquired extensive offices and works occupying some 30,000 odd sq. ft., at 111, Grosvenor Road, London, S.W.1. Eventually at this address the administration and sales offices, works, service station and stores will all be located. The new premises were taken over as from April 4.

Institute of British Foundrymen.

East Midlands Branch.

The final meeting of the Session was held at the Technical College, Derby, on March 21, Mr. S. H. Russell in the chair. Owing to Mr. H. H. Moore, of Loughborough, having been unable to prepare his Paper, three members prepared short Papers. Mr. J. Lucas (Herbert Morris, Ltd.), Loughborough, was the first speaker, on "Some Foundry Puzzles"; Mr. A. E. Peace, Leys Malleable Castings Company, Derby, on "The Works Chemist," and Mr. P. A. Russell (S. Russell & Company, Leicester).

Some Foundry Puzzles.

Mr. Lucas said many in their foundry experience came across things which have happened, but for which they were totally unable to assign a definite cause. He proposed to give a few examples. There was the puzzle of what contraction allowance a patternmaker should leave for the various metals. True, the patternmaker usually works to a contraction rule which gives all the standard contraction allowances for the various metals, yet he had come across instances where castings are far from correct to drawing dimensions, even though the patterns have measured correctly to the patternmaker's rule. Was the moulder at fault or the metal to blame, or is the patternmaker's rule incorrect?—he was puzzled.

The sketch (Fig. 1) shows a malleable iron casting, 9 to 10 in. long, the bosses being about 1 in. dia. A number of these castings were made, and were all jig drilled. Each boss had a hole drilled in the centre, but it was found the holes were more or less on one side. The patternmaker was blamed, but on examining the pattern and measuring it with the contraction rule it was found to be quite accurate. It was then thought the moulder might have used excessive force in rapping the pattern, but on comparing the castings with the pattern no evidence of undue rapping could be found. Yet the castings were slightly larger than the pattern. All they could do was to hope for the best next time.

Another puzzle, Fig. 2 indicates a crane barrel moulded and cast on end. The size is immaterial for discussion, as the puzzle happens with all sizes. The mould is rammed up in green sand, blacked and dried in the orthodox way. It is made in three or four sections, according to the length of the castings, and to give better facilities for drying, but it was always found that the casting came out longer in length than one would expect. Was the cause that the several sections of the mould do not go together so closely after drying as they were when green; or is there a strain at the top and bottom which is unperceivable in the casting; or has this particular type of casting some effect on metal shrinkage? One cannot discover, and so, knowing what will happen, precautions are taken in making the pattern to ensure more accurate castings.

A cylindrical casting, moulded and cast on its side with the pattern in halves and mounted on plates presents a third instance (Fig. 3). It had been noticed that none of these castings came out truly circular, but are always a little less than the pattern across the horizontal joint. How is it? Some might say it is due to side rap of the pattern, but as the patterns are mounted and machine-moulded no side rap could have any effect on the mould. Yet the trouble is sometimes more marked in some castings than in others. Why?

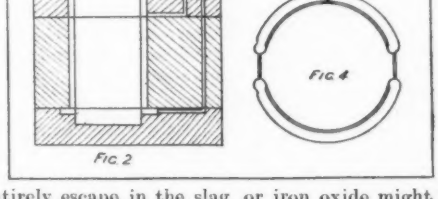
Take a semi-circular casting as in Fig. 4. The metal is T-shape in section, and the castings are moulded and cast on their sides. Yet when the castings are moulded up it is found that they always have a tendency to close inwards. From a close examination of the design one would have expected if any variation took place it would have been the castings would open outwards instead of closing inwards. The difficulty had been overcome somewhat by casting in pairs with a rib of metal between, which is removed in the fitting shop.

He had given a few puzzles met with from time to time, and many more could be given, and he hoped they would be brought forward and helpful points brought out for their guidance in foundry practice.

The Works Chemist.

Mr. A. E. Peace (Leys Malleable Castings Company, Derby) said: When he was first asked to give this Paper he was reluctant to do so because he knew that the majority of the members were practical foundrymen, and he anticipated that their requirements would be for a practical Paper. After some thought, however, it was decided to direct thoughts along technical lines. As a works chemist he had done his best to enlarge his knowledge of the art of founding, and in doing so had arrived at a definite conclusion, that the metallurgist in the foundry has to be the servant of the foundry. The laboratory in the works is simply a tool, and foundrymen have to intensify their technical knowledge to be able fully to appreciate and utilise the help which the laboratory can give. It is essential for the progress of the foundry industry that the metallurgist shall not become more learned in the practical side, important though that is, but that the foundryman must increase his knowledge of the scientific side.

That oxygen can exist in commercial cast iron having been established by so many analyses it is no longer open to question. It probably enters iron melted in the cupola under normal conditions, but it undoubtedly does so when the conditions are strongly oxidising and results in "burnt iron," which is recognised by everybody. Air strikes the molten iron as it is passing the tuyere area, and if in excess, some of the iron as well as Si and Mn and C are oxidised. The non-gaseous oxides tend to rise and be removed in the slag. The oxides would behave either in a similar manner to manganese sulphide which, as is known, does not



entirely escape in the slag, or iron oxide might be dissolved in the iron, as such. Also, it is possible that oxygen may be present as occluded gas.

If iron is held long enough at a high temperature in a reducing or neutral atmosphere all oxygen would probably be removed from it, at any rate, it would be freed of oxides, so that a very hot coke bed and deep well favour the removal of oxide.

The interest of oxygen to foundrymen is largely concerned with its effect on graphitisation. If oxygen is present in iron does it retard graphitisation? It is possible that the presence of oxygen raises the freezing point and shortens the freezing range. Thus it would give less time for the formation of graphitic carbon, and result in a stronger iron with higher combined-carbon content. An American, Mr. J. E. Johnson, claimed that oxygen improves cast iron. His point was that when oxygen is present the temperature at which the iron graphitises is lowered, relatively to the temperature of solidification, and that the graphite, being formed in a stiff mass, cannot grow into its familiar long flakes, but balls up into spheroids, thus giving a much stronger iron. He explained the generally greater strength of cold blast irons in this way, and in fact brought forward cold blast irons as evidence of the correctness of his theory.

In connection with cold-blast irons, he would be pleased if confirmation could be given of his experience that cold-blast irons shorten the life of molten iron.

No method of generally acknowledged accuracy has been developed for determining oxygen in cast iron, yet it has been stated that some American foundrymen regularly analyse for oxygen in

their pig-irons, and even influence their purchases by the results.

If this is true, it is high time that British foundrymen were enlightened on this matter. There is a distinct need for a correct method of determining oxygen in iron and identifying it and estimating it in the various forms in which it may be present.

Mr. Shaw's Paper on "Perplexing Foundry Problems,"* some few years ago, caused quite a stir on the subject of oxygen in cast iron, but unfortunately the storm of arguments has subsided and the matter is not now receiving the attention it deserves. Foundrymen should continually press for their research workers to investigate this problem and provide them with a satisfactory method of analysis.

In spite of the fact that so much is known about silicon and manganese and their behaviour, there are still many curious happenings due to them for which there is no explanation. It is known that more manganese is necessary to neutralise the effect of sulphur on graphitisation than is required theoretically. The amount has been found by experience to be about 1¾ times the sulphur percentage (*i.e.*, the theoretical quantity), plus 0.15 per cent. This is vouched for by H. A. Schwartz, of the National Malleable & Steel Castings Company of America, and has been confirmed by the speaker. Above this quantity of manganese it is generally held that under normal conditions the manganese exercises a hardening effect, by forming a double carbide, which is more stable than the simple iron carbide. Mr. Evans, however, recently suggested to the speaker that increasing the manganese slightly above the quantity usually allowed for to neutralise the sulphur effect would soften the iron. This was proved, and an increase of from 0.1 to 0.25 per cent. above neutralising quantity did produce a softer iron. It was found, as expected, to be independent of any effect on the sulphur as the content of this element remained unaltered.

The manganese was added to the ladle in the form of 80 per cent. ferro-manganese, and 4 oz. were used to 1 cwt. of iron. The addition caused considerable bubbling in the metal, and a slight scum formed. The fluidity appeared to be increased. White iron, which was unmachinable, was with this treatment rendered appreciably softer, and could then be machined. Only about 70 per cent. of the manganese added remains in the iron. It is suggested that this is allied to the oxygen problem, and that the manganese simply acts as a deoxidiser. It is realised that the matter could be investigated further with advantage.

If anyone can verify or disprove these observations it would be appreciated. It would also be interesting to hear of any other explanations that can be offered for the effect produced.

Chromium in Cast Iron.

Some time ago, Mr. Evans stated to the speaker that there was an indiscriminate use of ferro-chrome additions to cast iron by some foundrymen. He (Mr. Peace) also had knowledge of chromium being used in the manufacture of grey-iron castings. It is generally accepted that chromium hardens cast iron and increases the chill. It forms double carbides which are very stable, and its effect is to restrain graphitisation. It is very probable that chromium exerts other influences on cast iron which might be utilised to advantage. There is a useful field here for investigation by research workers. Grey-iron scrap which is on the market to-day may contain considerable percentages of chromium, and this element may be introduced into cupola mixtures without any warning. Its effect would be apparent in the machine shops, and also the fracture would be altered. It would probably take considerable time to locate the cause of the hardening, and then the removal of chromium from the shop scrap can only be accomplished by dilution.

Whilst no adverse criticism can be made against foundrymen experimenting with chromium additions and utilising it to obtain desired qualities, there should be some means adopted to prevent castings containing chromium arriving on the scrap heap mixed up with ordinary grey-iron scrap, and with no clue to its identity.

* See F.T.J., Vol. 24, page 257.

In conclusion, he referred to the apprenticeship problem. Mr. Faulkner made the greatest progress to the solution of this problem, when he said at the Annual Branch Dinner, that the Institute of British Foundrymen were shouldering a burden which should be borne by someone else. The members had done their share by realising its importance and by bringing it to the front, but surely it is the employers who should frame the solution. Employers will encourage youths to become engineers, they will have a scheme of education by passage through the various departments, but they will only do one of two things with the youth in the foundry. They either forget him, or else they take him out and teach him to be a fitter because he is too intelligent to stop in the foundry.

If the employer would guarantee a continued interest in a lad, he was sure the schoolmaster would soon give the foundry the right material.

Mr. P. A. Russell illustrated his remarks with lantern slides, showing the composition of cast iron. He disclaimed any intention of a set Paper, but thought it well to review their knowledge of the composition of the metal.

DISCUSSION.

Mr. Evans remarked one was up against problems at every turn and had, more or less, to rely on empirical knowledge. When a skilled moulder got hold of a difficult thing he studied it from the standpoint of getting a good casting.

In answer to questions Mr. Lucas said, with regard to the density of the mould and the temperature of metals causing variations, there might be something in that as well as the way the moulder used his pattern. He generally found that with various foundries to which they sent patterns they did not get the same contraction; there must be something wrong. It appeared that no foundry could do everything.

Mr. Stevenson asked what was the effect of adding aluminium to molten iron.

Mr. Russell said aluminium was essentially added, not with the point of view of increasing strength, but as a de-oxidiser, and was certainly very useful, but if there is good iron in the first case there is no need to add it.

The President said that without passing a formal vote of thanks they could express their pleasure and thanks to the speakers.

Mr. Stevenson moved a vote of thanks to Mr. S. H. Russell, who had been an ideal President, and as the incoming President he would be satisfied if he could do half as well.

Mr. Evans, seconding, said Mr. Russell had given the whole of his time to the work and had given them real good service in many ways.

In reply to the unanimous vote, Mr. Russell said he had been well repaid by the interest and enthusiasm shown by members. It had been difficult at times to fit in the work with his own business, but he had not missed a meeting during the two years, and he could assure them he had really enjoyed the office.

Scottish Branch Annual Meeting.

The annual meeting of the Scottish Branch of the Institute of British Foundrymen was held in Glasgow on March 28. Mr. James Affleck, president, was in the chair, and there was a good attendance of members.

Mr. John Bell, secretary, submitted the annual report, which showed that during the year the Scottish Section has made steady progress in many directions. Mr. Bell reported that there are on the register the names of five honorary and life members, 48 members, 118 associate members, and 26 associates, making a total of 197. This shows a decrease of 39 compared with last year, but as was indicated at the previous annual meeting, it was necessary to remove from the register 30 or 40 names which ought to have been removed at a much earlier date. That was done just after the last business meeting, the names removed at that time numbering 44. In addition, the Institute had lost 11 members by resignation, two by death and three by transfer.

Against this, however, Mr. Bell recorded 21 admissions to membership, against four in the previous session. The details of these admissions

are: Two members, six associate members, 13 associates, making a total of 21.

It might appear somewhat disappointing to have to record such a reduction of membership, Mr. Bell said, but he thought the wise way to regard it was as a very wholesome pruning of dead wood, which in the end would make for much more satisfactory and rapid growth.

During the session that closed that day there had been seven branch meetings, and, excluding that day's meeting, the average attendance throughout was 58. This figure was in advance of that for last session, when the average attendance was 40 The largest attendance was 71 on December 6, 1924, against 51 for last session, an increase of 20.

Some Outstanding Events.

Leaving the statistical side of the affairs of the Branch, Mr. Bell said he wished to refer to four items of importance. In the first place, he said there was the very excellent presidential address delivered by Mr. Affleck. This address had done not a little to enhance the prestige and raise the status of the foundrymen's organisation in Scotland. Mr. Bell said it was not his intention to do more than record the fact, but he wished to say in passing that that address had been most favourably received in many places other than in Scotland, and had been noticed in the foreign Press.

Diesel Engine Castings Symposium.

In the second place, he wished to draw attention to the joint meetings which the Scottish Branch had held with the local branch of the Institution of Mechanical Engineers for the purpose of discussing questions relating to the production of castings for Diesel engines. What were at first very informal discussions on the part of two small sub-committees were very substantially advanced when the first joint meeting was held on October 18, 1924. This was followed by a meeting on February 9, 1925, for discussion, and as they were aware, after 2½ hours' discussion, the meeting had to be adjourned. At these meetings there had been, perhaps, little more than a stating of the case on both sides, but the great step forward on the part of the foundrymen lay in obtaining acknowledgment that they have a case, and in having entered into discussion with a kindred society in which they could reasonably claim to have made a material contribution to the subject under review.

In the third place, he wished to record with pleasure that a diploma had been again awarded to the Scottish Branch, the recipient in this case being Mr. J. H. Gardner, Kilmarnock, who was a member of the Council, and whose Paper on "The Briquetting and Use of Cast Iron Borings" was read before the Scottish Branch. The diploma was presented to him at a meeting in January last, when the Branch welcomed the president, Mr. R. O. Patterson, and the president-designate, Mr. John Cameron.

New Section in Paisley.

The fourth item to which he wished to refer was the holding of a meeting in Paisley Technical College on February 13, when 98 members and visitors were present. Arising out of that meeting a subsequent meeting of some of the Paisley members was held, and on March 25 it was decided to proceed with the formation of a section in Paisley. The local arrangements are as yet very incomplete, but he was pleased to say that Bailie Galt, who joined the British Foundrymen's Association in 1904, and was, he thought, the oldest Scottish member, had agreed to become the first president, with Mr. George Mackay as vice-president and Mr. James Anderson, Vulcan Works, Paisley, as secretary.

The financial statement of the Scottish section for the year ended December 31, 1924, showed that, so far as its finances are concerned, the section is in a very satisfactory condition.

THE CHAIRMAN, in moving the adoption of the report, said he thought it was a very able statement, and reflected accurately the activities of the Branch during the year. It was a matter of gratification that the Branch was in such a thriving condition, and for that much credit was due to the honorary secretary, Mr. Bell, who had done valuable work for the Branch.

The report was adopted unanimously.

Office-bearers were appointed as follow:—President, Mr. James Affleck; vice-presidents, Mr. Mearns and Mr. Thomas Bell; honorary secretary, Mr. John Bell; members of Council, Mr. Littlejohn, Mr. Young and Mr. R. D. Laurie; representatives to the General Council of the Institute, Mr. Winterton, Mr. Primrose and Mr. Campion.

The Waste Heat Problem.

BY OUR ENGINEERING CORRESPONDENT.

One of the most important sources of national fuel economy to-day is the utilisation of waste heat, not only in the iron and steel industries, but many others as well, such as, to take a few examples, cement, chemical manufacturers, and the carbonisation of coal in the town's gas and metallurgical coke processes. For this work extremely important is an efficient non-conductor of heat for use on trunking and able to stand the extremely severe conditions averaging, say, 800 to 900 deg. F., ordinary steam boiler and pipe coverings being of course quite unsuitable. In this connection of particular value is the "Caloperite" covering of Messrs. Sutcliffe Bros. & Bryce, Ltd., of Hyde, near Manchester, which is guaranteed to withstand continuously a temperature of 1,000 deg. F. (535 deg. C.) at the same time saving 90 per cent. of the heat loss, a remarkable combination of properties. Thus, for example, detailed tests carried out by the Engineering Department of the University of Manchester show that at the above temperature there is not the slightest trace of charring or disintegrating effect, and this is also proved on large scale experience. Some time ago, for example, a sample was taken of "Caloperite" covering that had been in use for 18 months on a hot blast main pipe in a well-known steel works, that of the Thomas Butlin & Company branch of the United Steel Companies, Limited, Irthlingborough Iron Works, Wellingborough, in which the average temperature all the year round is 850 deg. F. The material was found to be quite uninjured, and the company are of the opinion that it is satisfactory at 900 deg. F.

With regard to the non-conducting properties, detailed series carried out by the National Physical Laboratory at Teddington in 1923 showed that the saving on a bare steam pipe under ordinary high-class industrial conditions of 157 lbs. per sq. in. pressure and 369 deg. F. (185 deg. C.) was 83.2 per cent., with 1.6 in. thickness of material.

By using slightly more of the material, say a standard 2 in., about 90 per cent. of the heat is saved, as already indicated. In connection with superpower station steam conditions, say 350 lbs. pressure and 725 deg. F. superheated steam temperature, the principle is generally adopted of using about ½ in. of "Caloperite" next to the pipe to take the first shock of the heat, followed by ordinary good grade material, 85 per cent. magnesia, telluric coverings, or "Crown" asbestos, finished off in any convenient manner, hard setting composition, canvas, or sheet metal, all of which the firm supply for the conditions. Finally also, it may be emphasised, scientific methods of this description are a handsome investment for all steam conditions, even in the case of heating, locomotive, and crane boilers.

SCHURR & COMPANY, Norfolk House, Laurence Pountney Hill, Cannon Street, London, E.C.4, are the agents for N.V. Centrale Handelsvereeniging, Rotterdam, who sell the whole of the output of the various works comprising the Thyssen concern, only in so far as material for export is concerned.

THE FLOATING DOCK being employed by Cox & Danks, Limited, in connection with the salvage of the German fleet at Scapa Flow, has been damaged by fire. In righting one of the destroyers preparatory to raising, large quantities of oil were released from the hull and spread over the water around the dock. Apparently a spark from the boiler furnace on the dock ignited the oil, and the flames spread to the dock itself. Workshops were badly burnt, but the lifting gear is practically undamaged.

XUM

Desulphurisation, Degasification, and Deoxidisation Process for High-duty Cast Iron.*

By Joh. Mehrtens, Berlin.

INTRODUCTORY.

The endeavours which have been made during the past few years in ever-growing measure to improve the properties of cast iron in regard to density, strength, resistance to wear and chemical influences in response to modern requirements, and not least the difficulties which has everywhere been felt owing to the lack of high-grade coal, coke and pig-iron, have rendered the employment of purification processes imperative.

It was sulphur which in the first place was always regarded as a very troublesome element both in pig-iron and cast iron. Although its operation is less observable in an unfavourable effect on the strength properties of cast iron, the more markedly apparent viscosity and the increased contraction in the finished castings which accompany an increased sulphur content were in themselves sufficient reason for combating the excess of sulphur. But the hardness and brittleness of cast iron also increase with the sulphur content, and cast iron solidifies more rapidly in proportion to the sulphur content, even when the chemical composition remains otherwise almost identical.

Sulphur is present in all kinds of pig-iron. In the cupola process it receives a further and quite considerable increase, so that sulphur contents up to 0.20 per cent. and more are by no means uncommon in cast iron in foundry cupola work.

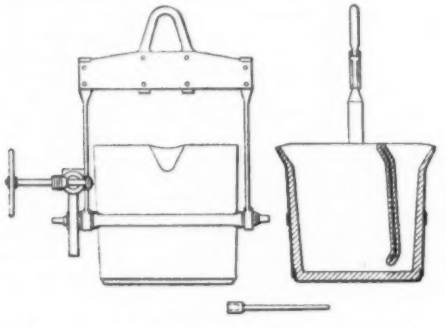


Fig. 1.—Slag Skimming Ladle (Senssenbrenner Type).

The sulphur concentration increases in proportion to the cast-iron scrap in the iron charge.

In normal circumstances remelting in the cupola has no favourable effect worth mentioning on the sulphur content; as a rule, indeed, it increases. To remedy this drawback an addition of limestone —sometimes also limestone and fluor-spar—is given with every iron charge or coke charge, the addition being 15 to 25 per cent. of the coke charge according to the ash content of the coke. The affinity of sulphur for iron is very considerable; it combines also with other metals, in particular with manganese. A higher manganese content in cast iron is desirable, chiefly because it operates favourably in diminishing the sulphur content.

This property of manganese, therefore, renders it possible to free liquid pig-iron in the ladle or in the pig-iron mixer from a considerable portion of its sulphur content, as the manganese sulphide rises to the surface of the iron bath owing to its lower specific gravity. The sulphur content of the pig-iron can be decreased by one-half in the mixer; this simple process is therefore of the greatest importance in the manufacture of steel.[1]

Like sulphur, copper also is very harmful in pig-iron. So, too, are the gaseous and solid impurities which are formed by an excess of oxygen with the liberated elements C, Si, Mn, P and Cu. A portion of indissoluble compounds present in the iron bath collects on the surface owing to their lower specific gravity; but as the temperature decreases large amounts of oxides and sulphides remain confined in the bath, and these often cause disturbances in the solidification process (disintegration and liquation). In a remarkable contribution on the subject of the desulphurisation of pig-iron and steel, B. Simmersbach has shown the importance of these processes in the production of ingot iron.[2]

Various Desulphurising Agents.

The unpleasant consequences of troublesome admixtures in the molten cast iron for high-duty castings of all kinds have been particularly noticeable during the past few years. The shortage of pig-iron and foundry coke have had a considerable influence in leading foundry experts to exert redoubled zeal in solving the question of desulphurisation and purification in regard to cast iron. The methods adopted have been of different kinds. In the first place the known limestone additions in the melting furnace were increased, and at the same time additional attention was paid to the use of fluor-spar. Many foundries have altered their methods by permanently replacing a portion of the limestone by fluor-spar, so that generally two-thirds limestone and one-third fluor-spar are employed. Certain successes might be recorded, but it is necessary to note that the fluor-spar addition, which frequently contains sulphur compounds, must be kept within certain limits. The fluor-spar, however, gives a rather more fluid slag, which may cause scaffolding. But it must not be overlooked that the principal object of these additions is to transform the coke ash, the sand adhering to the pig-iron and scrap, and rust, etc., into slag. This slag comes into consideration only secondarily for changing the sulphur contained in the coke into calcium sulphide (CaS). This effect is generally, however, very slight. It is sufficient to make the additions not more than about 30 per cent. of the coke charge, as otherwise the furnace lining is subjected very much to slagging and the result expected is entirely absent.

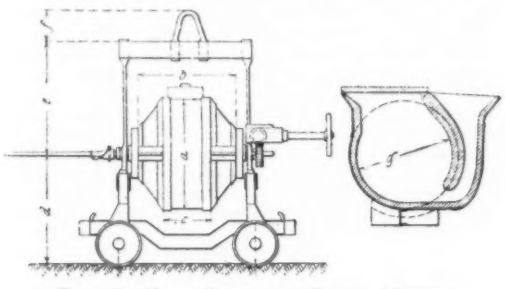


Fig. 2.—Slag Skimming Ladle (Ardelt Works Type).

Other experiments in which the manganese content was increased are said to facilitate desulphurisation of the cast iron in the charge. The results, however, have not been satisfactory. It appeared that in many cases the higher manganese content in the charge affected the increase of the sulphur but little. A better result was obtained in the experiments of Greiner, who employed small manganese blocks to prevent the absorption of sulphur in the melting furnace. The author has published a report on the subject with illustrative figures in the technical journal "Gusseisen" (Julius Springer, Berlin).

The Walter-Durkopp-Luyken-Rein Desulphurisation Process.

A revolution took place when the results of the experiments of Walter with alkali salts and

* Translated from "Stahl und Eisen."

[1] W. Mathesius: "The Physical and Chemical Bases of Iron Working" (Leipzig: Otto Spamer, 1916), p. 105.

[2] "Chemiker Zeitung," 46 (1922), p. 65-68.

alkaline earth salts, carried out by him in conjunction with well-known experts, became known. A detailed report of these experiments, which were made simultaneously in several foundries (Dortmund, Mülheim, the Pegnitz Ironworks and Berlin-Tegel), was given by Scharlibbe[3] in a lecture to the German Foundrymen's Association, entitled "The Desulphurisation of Molten Cast Iron." Like Walter, Emmel and Schumacher, he was able to show that no reduction of the sulphur worth mentioning is effected by increasing the manganese content.

On the other hand, by employing the Walter additions in the ladle or in the receiver, it was found that with both low and high manganese charges the desulphurisation obtained was almost equally favourable. Careful analyses from different foundries confirm the fact that by employing the Walter method no concentration of manganese took place; a slight decrease in the manganese content was, however, observed, and accordingly a manganese content was always shown also in the desulphurisation slag of the tests examined.

This process is dependent upon a simple chemical change, in which sulphur in the form of sulphide is combined with the combinations of the alkalis and alkaline earths. These processes were known even before the Walter experiments, and were

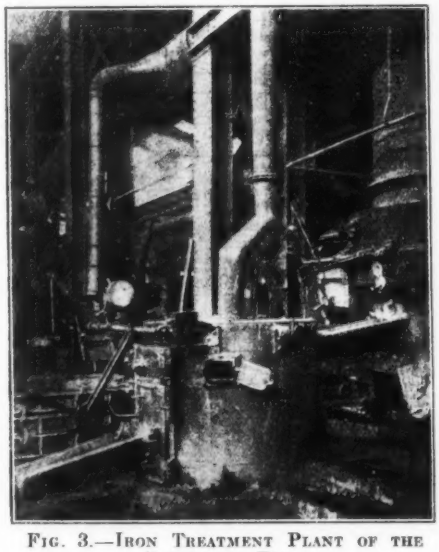


Fig. 3.—Iron Treatment Plant of the Scharlibbe Type.

employed particularly in the manufacture of steel. Walter, however, was the first to recognise and take into account the effect of silicic acid on the alkaline earths, the oxides and hydroxides of the metals calcium and barium, and of the alkalis, particularly of potassium and sodium, which combine with silicon much more rapidly than with sulphur. In employing the process, therefore, he excluded the silicic acid which operates so detrimentally—that is, in this case, the acid furnace slag. Care had, however, to be taken that the alkali and alkaline earth additions were suitably chosen, in order that in removing the sulphur the silicon and carbon should not also be attacked.

The liquid furnace slag, even if it contains no free silicic acid, has a disturbing effect on the desulphurising process, as the alkali very easily decomposes the silicate compound, attracts the silicic acid to itself, and repels the sulphur already combined in the furnace slag as sulphide to the liquid iron again.

The desulphurisation slag itself also acts similarly. For this reason no moulding sand or dry sand should be thrown on the iron bath in the ladle, if the desulphurisation slag has already combined sulphur, as resulphurisation is thereby caused. Here the noteworthy experiments of Emmel may be referred to, which were published in the "Giesserei Zeitung," 19 (1922), p. 47, Table III.

[3] "Giesserei Zeitung," 19 (1922), p. 43-46; "Stahl und Eisen," 42 (1922), p. 137-40.

Walter and his collaborator first carried out the experiments in ordinary ladles of different sizes, with a capacity of over 500 kg. The results at the foundries of Thyssen, Mülheim and the Pegnitz Ironworks prove that with some care on the part of the men casting complete success in regard to desulphurisation can be ensured.

In many foundries the removal of the sulphur slag from the iron bath creates difficulties. The modified type of construction with slag skimmer (Fig. 1, the Senssenbrenner crane ladle; Fig. 2, the Ardelt Works drum ladle) and the similar type according to Dechesne greatly diminished the trouble caused by thin liquid slag, but it was still noticeable. In addition, the workmen complained of the desulphurisation units, which sometimes prevent casting unless adequate precautions are taken for carrying off the gases at some particular point in the foundry.

In order to combat these difficulties Scharlibbe installed a special iron-receiver with inlet opening and outlet pipe in front of the melting furnace (without receiver) as in Fig. 3. No change was made in the furnace itself. The iron receiver is connected with only a short tapping spout. As in all ordinary cupolas, the acid slag is drawn off from time to time by a slag notch. Only slag-free iron, therefore, runs into the receiver, and to this the desulphurising agent is added.

To pre-heat the receiver adequately or to prevent it from cooling in certain cases and at intervals of waiting an oil burner is preferably used from time to time. It was found that the hotter the iron came from the furnace and the longer it was exposed to the influence of the desulphurisation slag, the greater was the desulphurisation effected. It was further found that a highly basic lining in the desulphurisation fore-hearth is unnecessary, but that an acid lining of luting sand affected the desulphurisation process disadvantageously. As Scharlibbe reported in his lecture to the German Foundrymen's Association in 1921, and as Emmel confirms, all the castings made from the desulphurised iron were sound. They showed neither porosity nor pipes, thereby proving that simultaneously with the desulphurisation a very extensive degasification and deoxidisation of the iron had also taken place.

The advantages of this process are seen not only in the avoidance of defects, but also in the greater machinability of the cast iron, the saving in tools, and not least in the cheapening of the iron charge by larger quantities of cast iron scrap. In addition, a reduction in the runner heads and risers (particularly in cylinder castings) is observable, so that it was easy to prove the economy of the process notwithstanding the cost of the desulphurising agent, the alteration of the furnace and the fee for its use.

The Walter process has been adopted in several large foundries, a detached iron-receiver being employed, which, after the iron has been desulphurised, can be taken on a travelling crane from the furnace to the casting floor. If its success was not everywhere uniformly apparent, this was mainly due to the working conditions and to the nature of the castings, which cannot always withstand the cooling of the iron to be cast. The placing of an oil burner in the iron-receiver was sometimes also found troublesome.

During the last two years the employment of the melting furnace with built-in receiver, with the simultaneous installation of a slag box of the Rein type and an overflow between cupola and fore-hearth, has brought about an important development of the process. At the instance of the Allgemeine Brikettierungsgesellschaft (Dr. Schumacher & Company), extensive new experiments were carried out at the Dürkopp Works in Bielefeld. In these the Rein slag box (German patent 343,959), which was later supplemented by the connecting channel between furnace shaft and fore-hearth (German patent 361,359), was used. While the slag box alone at first merely received the collected slag which ran off at the highest level of the iron in the fore-hearth, the amended type of construction provided with a discharge spout was capable of fulfilling an important task, namely, that of separating the molten iron from the slag in the cupola so that the slag-free iron could at once flow into the fore-hearth. The value of the

slag collector in the development of the Walter desulphurisation process has been everywhere recognised.

Luyken does not, like Rein, employ any open overflow enabling the furnace gases to enter the fore-hearth; he uses an overflow channel of a particular section which, being filled with molten iron while working, shuts off the fore-hearth from the furnace shaft. Thus the receiver remains pressureless, in contradiction to the Rein arrangement.

The adoption of either type of construction must be decided according to the particular circumstances of the case, in the light of space and the special working conditions of the melting plant concerned. The rule has been evolved that in furnaces with a low fusion zone the Rein overflow type is to be preferred.[4] As, moreover, the Rein connecting channel has an access to the fore-hearth only for the passage of the iron, the slag receivers can be connected both to the furnace shaft and the fore-hearth. There may be exceptions owing to lack of space or difficulty in installing the receivers. The size of the receivers themselves is determined by the melting capacity of the furnace or by the amount of the daily production of slag.

Fig. 4 shows a melting furnace with both fore-hearth and slag receiver. The overflow between cupola and fore-hearth, according to Dürkopp-Luyken, is only indicated. Further details are shown in Figs. 5 and 6, which are views taken during work.

Apart from other more or less known processes, such as with the employment of fermasite and oxidation briquettes, the characteristics of which are not here discussed, it may be further mentioned that the idea of an overflow, although materially different in form and operation, has already had precursors. Such apparatus for the retention of the slag directly in the tapping gutter have been installed even with furnaces without receivers; of these the Löhe type (German patent 347,088), among others, has been used in several foundries. A slagging-out fore-hearth has also been constructed by Dechesne (German patent 389,963 and addition 399,315). The fore-hearth is divided into two chambers by a wall. The hearth of the furnace is on the same level as the hearth of the fore-hearth and the tap-hole. The partition wall in the fore-hearth serves simultaneously as overflow. For the purpose of removing the residual iron the partition wall is provided with a tap-hole. The patent of addition does away with the partition wall in the fore-hearth; instead of it, however, another tap-hole placed higher, with a spout, is provided. The working results of this arrangement have not yet been made known.

According to the available reports on the Walter process in conjunction with the Dürkopp-Luyken-Rein fore-hearth, this arrangement appears to offer the greatest reliability in operation. The results of the tests made in many foundries show that, compared with the normal melting process with the ordinary furnace, the greatest possible improvement is effected in the molten iron.

Working Arrangement of the Furnaces.

The following remarks may be made regarding the adaptation and working arrangements of the melting plant for the employment of the Walter process in the receiver. The process can be carried out in any cupola furnace with a fore-hearth attached. If there is no fore-hearth, one must be obtained suitable to the conditions of the furnace. A slag receiver is also requisite, the dimensions of which must be adapted to the amount of slag or the daily melting capacity of the furnace. According to the type of furnace, the slag receiver can be connected to the furnace shaft or to the fore-hearth, the decision to employ the Dürkopp-Luyken or the Rein overflow being also dependent upon this. It is desirable in any case to test the furnace measurements carefully by the aid of the drawings. The construction of the overflow and the arrangement of the inlet connection for the desulphurising agent are uniformly determined. The last-named apparatus can be fixed not only laterally on the plate covering, but frequently also on the cover of the fore-hearth. Here also the particular conditions of the melting plant must be taken into account. The fore-hearth retains the discharge pipe with throttle flap as in the Scharlibbe type of receiver; latterly, on the other hand, the discharge pipe on the slag box has been replaced by a slide valve with flap and safety valve. The slide valve enables the flow of slag into the receiver to be regulated.

The brickwork of the fore-hearth and the overflow demands special attention. In the former ordinary hard-burnt side-arched brick has proved most resistant; special bricks, therefore, are not necessary. An alumina content of 40 to 42 per cent. is desirable; it is essential, however, that the bricks shall be thoroughly burnt. To avoid large joints it is desirable to fit the bricks as closely as possible. The joints themselves should be carefully packed with the same brick substance. In any case the sulphur slag must be prevented from finding large points of attack in the fore-hearth. For the brickwork of the overflow moulded bricks made to a special design according to the circumstances are more suitable.

In the furnaces of the Dürkopp foundry, after every run the lower half of the fore-hearth is

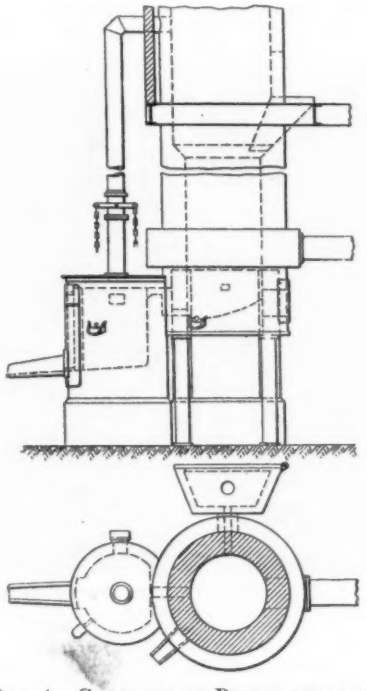


Fig. 4.—Cupola with Desulphurisation Forehearth; Dürkopp Luyken Overflow and Rein Slag Receiver.

well grouted with a thin loam mortar, with which ground fragments of graphite are mixed. This materially increases the durability of the fore-hearth lining; for some four or five weeks no work worth mentioning is necessary. It is essential, however, that any cracks which occur must always be repaired after removal of the slag residue before they get larger.

The success of the process is naturally also dependent on the more or less careful supervision of the melting plant. Readers are therefore referred to the well-known principles of melting work.[5]

It is of great importance for getting regular melting conditions that only selected compact pieces of medium size (that is, over first size) shall be used as heating coke, as in that case the flow of both iron and slag is ensured. No flux (limestone and fluor-spar) need be added to such coke.

If an interruption in the iron flow is observed this is remedied with an iron rod inserted through the upper door of the fore-hearth. In the Dürkopp-Luyken system an emergency tap-hole is

[4] The exploitation of the entire process is in the hands of the Allgemeine Brikettierungsgesellschaft, D. Schumacher & Co., Berlin and Dortmund.

[5] Published by the author. "Stahl und Eisen," 44 (1924), p. 1555; "Giesserei," 11 (1924), p. 831.

provided above the throttle flue; this must be renewed with moulding sand and loam after each run.

The sulphur slag collecting in the fore-hearth must be removed once or oftener when the output is large—over 15 tons a day; it is either drawn off, or a small slag receiver must be built on to the fore-hearth for the purpose.

The slag receiver on the cupola must not be opened immediately after the run is finished, the solid block of slag is not removed until the following morning. Large furnaces with a daily melting capacity of 50 tons and above form an exception; in this case periodic tapping of the furnace slag is desirable, and the doors may be opened sooner—that is, after a few hours. It is advisable to have a special slag receiver for each furnace. The inside of the receiver—the iron plates—are coated over with a thin coat of loam each time after being used.

It is important also that the fore-hearth should be thoroughly pre-heated before each melting, particularly if repairs have taken place. If thin-walled small castings are being produced it is particularly desirable that the fore-hearth should be pre-heated. In this connection it may be mentioned that iron with a sulphur content of about 0.05 per cent., even with 0.5 per cent. phosphorus, shows the same fluidity as a normal iron with a phosphorus content of 1 to 1.5 per cent.

Walter's desulphurising agent is put up and sold in small rectangular blocks weighing 1 kg.

Fig. 5.—Dürkopp-Luyken Desulphurisation Forehearth.

The agent consists, as already stated, of a mixture of various alkalis, in which soda preponderates.

The addition is made as soon as the bottom of the fore-hearth is covered with iron; the blocks are preferably placed in the charging apertures crushed. Generally an addition of 0.5 per cent. is sufficient, even with the highest proportions of cast-iron scrap, to decrease the sulphur content by 40 to 50 per cent.; after the addition, iron with about 0.15 per cent. sulphur shows about 0.08 per cent. sulphur and less. A few figures are given by way of example:—

	Per Cent. S. *a*	Per Cent. S. *b*	Per Cent. S. *c*	Per Cent. S. *d*
First tapping	0.099	0.074	0.107	0.090
After 8 tons	0.045	0.053	0.066	0.065
Residual iron	0.124	0.101	0.115	0.131

A sample of the last-named iron *d*, taken from a casting, showed a sulphur content of 0.042 per cent. with 2.56 per cent. Si.

The residual iron above-mentioned comes from the hearth of the cupola, and is removed when the run is completed before emptying the furnace. The amount of this remainder iron varies according to the capacity of the furnace, viz., 50 to 200 kg.

Care must be taken to keep the fore-hearth as well filled with iron as possible, in order to secure good desulphurisation and maintain the iron at a uniformly high temperature.

Attention should be paid to the suitable arrangement of the cupola. The hearth must be given a trough-shaped depression on the side of the throttle flue, and must rise on the other side at an angle of 30 to 40 deg. When so constructed the amount of residual iron is small. If the angle of slope is more than 40 deg., sand from the hearth may accumulate in front of the throttle flue. The residual iron can certainly always be used for simple castings; otherwise there is nothing to prevent it from being cast in pig moulds and melted down again.

As the iron first melted collects on the hearth, if the pre-heating is adequate there is scarcely any question of the overflow channel being solidified. In blowing in the furnace the charge opening for the desulphurising agent remains closed; the tapping hole in the fore-hearth, however, remains open so long as blast air is admitted to the fore-hearth. If the through blast interruptions, or when the first iron appears on the cupola hearth, the tap-hole may be closed. The rise of the iron can be observed through the inspection hole in the fore-hearth door.

The application of the desulphurising agent takes place in proportion as the iron is drawn from the fore-hearth. For every 1,000 kg. of iron drawn, about 5 kg. of desulphurising briquettes should be thrown into the fore-hearth. The addition of the agent is then continued according to the amount of iron required. The desulphurisation slag should be thinly liquid and be in constant motion. The degasification is generally clearly visible. If the slag becomes viscous or inert, there is some defect in the brickwork of the fore-hearth

Fig. 6.—Rein Slag Receiver (left—closed; Right—open).

or sufficient desulphurising briquettes have not been added.

After the melting has been completed no desulphurising agent need be given for the last charge of the fore-hearth. After the fore-hearth door is opened the fore-hearth slag is as far as possible collected in iron buckets.

It may be further mentioned that when the melting process is finished an anchor bolt is inserted in the principal slag receiver, in order to be able to remove the block more easily by means of tackle attached to it.

Advantages of the Process.

In what way, then, are the advantages of the process apparent, and is the process economical, particularly when used in melting furnaces with overflow and slag box? Although the investigations of the effects of the process have not yet been completed, these questions can be answered in the affirmative, having regard to legitimate demands for an improvement in the quality of cast iron.

The detrimental effect of sulphur on the mechanical properties of cast iron is known to every foundry manager and every engineer who has to do with the working of cast iron. From experiments by Wüst and Miny with various iron mixtures with sulphur contents of 0.01 to 0.25 per cent., it appears that, according to the presence of manganese in the molten iron, the effect of the sulphur on the separation of graphite also varies. The sulphur has little influence on the amount of graphite, its operation being contrary to that of silicon; on the other hand, the temperature of the iron is of the greatest importance in the

formation of graphite. The sulphur content should not always be made responsible for abnormalities in cast iron.

In many cases the transverse and tensile strength of cast iron increases with an increasing sulphur content. With the highest graphite content it has the lowest bending strength; with 3.5 per cent. and more Si and over 2.20 per cent. graphite the strength properties are particularly unfavourable. With low manganese cast iron—below 0.50 per cent.—the effect of the sulphur on the strength is slight; if, however, the manganese content increases, the strength declines. The hardness of cast iron is dependent on the sulphur content, and accordingly a high sulphur-content is always detrimental for machinery.

With the same casting temperature high-sulphur cast iron shows a greater tendency to form blow-holes than low-sulphur iron. In high-manganese cast iron the mechanical properties deteriorate with an increasing sulphur content, and the hardness increases. The sulphur appears in the structure in the form of independent inclusions, the edge zones of the castings being generally distinguished from the core by a fine distribution of the sulphur.

Osann states[6] that sulphur is very harmful if only because it increases to an extreme extent the hardness and brittleness, as well as the amount of shrinkage, the tendency to develop pipes and stresses accompanying these. Moreover, sulphur favours liquation, whereby foreign bodies get into the casting, resulting in defective castings.

In the tests of the use of the Walter desulphurising process these observations were fully confirmed by the results. In certain cases, however, it appeared that desulphurisation had less effect in improving the quality if less than 0.10 per cent. sulphur was already present in the iron. This fact may be seen from the slight change in the strength figures of the test bars which were cast from desulphurised and non-desulphurised iron. Of this Table I may be given as an example.

In the tests mentioned above the cast iron used was principally melted from cast iron scrap with shop scrap (gates, etc.) and 10 to 30 per cent. of pig-iron. The high silicon content in the test bars 1 to 4 is due to the addition of silicon briquettes (Esslingen Engineering Works). With the exception of test pieces 5 to 8 the metal was ordinary machine cast iron for small thin-walled castings. In bars 15 and 16 an iron with 30 per cent. shop scrap was cast; bought scrap was not used, which explains the low sulphur content of 0.059 per cent. in the non-desulphurised bars. In all cases desulphurisation was apparent to the extent of about 50 to 60 per cent. The transverse strength and tensile strength, as was to be expected, were only slightly increased by the desulphurisation; in certain cases they remained unchanged or declined slightly. The cause of the differences is to be looked for in the varying composition of the iron. Accordingly the hardness of the test pieces, apart from bars 15 and 16, also shows no decline worth mentioning. In bars 9 to 12 it even increased. But nevertheless the machinability of the desulphurised cast iron was not impaired. In all cases the reports from the machine shop show that the desulphurised cast iron effects a material saving in cutting tools, so that leading works make it a condition that no cast iron products shall be supplied with a higher sulphur content than 0.06 per cent.

The structure of bars 13 and 14, taken in connection with the investigations of the Institute for Iron Research (Eisenforschungsinstitut) showed no differences in structure worthy of mention with 0.110 and 0.036 per cent. S. In this case, owing merely to the re-employment of the already highly desulphurised gates and other shop scrap, an extensive purification of the non-desulphurised iron was effected, and this is apparent in the structure; in the fracture appearance of the two bars no great difference is discernible.

From the behaviour of the cast iron produced by the Walter process it may be concluded that the desulphurisation effects important results in regard to quality in the liquid metal. It has been shown that with the cheapening of the iron charge by the use of larger quantities of bought scrap (up to 50 or 60 per cent. and more), together with the so-called domestic scrap, even for the production of delicate castings which suffer much from shrinkage and strain, such as thin-walled casings, protecting caps, pulleys and the like, every difficulty can be obviated by the desulphurising process. There was no longer any contraction or tearing of the pulleys, so that the cost of extra working could be reduced to a minimum.

The behaviour of the cast iron in regard to shrinkage should be further observed by means of comparative tests with iron mixtures of different

Table I.—*Tests on Desulphurised Cast Iron.*

Test No.	Bar No.	Foundry.	Analyses. Total C.	Gr.	Si.	Mn.	P.	Strength in kg/mm². S.	k_z.	k_b. *	Deflection in mms.	Hardness (Brinell)	
1	I a	A.	3.22	2.53	3.69	0.37	0.70	0.139	14.70	28.20	7.5	206	not desulphurised
2	I b		3.14	2.57	3.47	0.36	0.68	0.062	16.60	34.10	9.5	198	
3	II a		3.09	2.45	3.94	0.34	0.73	0.125	15.20	30.30	8.6	202	not desulphurised
4	II b		3.17	2.51	3.60	0.34	0.71	0.043	15.70	35.40	9.6	189	
5	III a	B.	3.37	2.56	2.35	0.34	0.90	0.116	19.30	33.80	8.4	211	notdesulphurised
6	III b		—	—	—	—	—	—	20.10	40.60	10.2	204	
7	IV a		3.38	2.69	2.12	0.35	0.92	0.055	19.00	39.30	9.8	205	desulphurised
8	IV b		—	—	—	—	—	—	18.80	39.10	10.4	201	
9	V a	C.	3.50	2.41	2.47	0.39	0.89	0.110	15.00	31.30	7.8	167	not desulphurised
10	V b		3.47	2.25	1.83	0.38	0.84	0.066	17.50	40.30	9.0	184	
11	VI a		3.78	2.60	2.02	1.21	0.31	0.070	16.00	36.80	10.2	162	not desulphurised
12	VI b		3.58	2.37	1.93	1.20	0.34	0.027	18.00	40.30	10.6	175	
13	VII a	D.	3.71	2.29	1.71	0.40	0.45	0.110	12.20	28.00	8.9	182	not desulphurised
14	VII b		3.90	2.40	1.48	0.38	0.38	0.036	14.70	32.00	10.0	163	
15	VIII a		3.73	2.62	1.86	0.40	0.46	0.059	15.20	31.70	10.6	164	not desulphurised
16	VIII b		3.80	2.65	1.78	0.38	0.46	0.026	17.30	35.10	9.4	154	

Table II.—100 *Grams of Cast-Iron Contained.*

Description of Cast-iron.	S %	Desulphurisation %	CO_2 cm³	CO. cm³	H_2 cm³	N_2 cm³	Total gas content cm³	Gas decrease %	Brinell hardness.
12,622A, non-desulphurised sample	0.096	—	4.53	49.27	31.78	0.0	85.58	—	315
The same, desulphurised	0.052	45.8	1.35	10.34	31.16	1.20	44.05	48.6	293
19,622B, non-desulphurised sample	0.089	—	4.13	45.42	11.58	3.79	64.92	—	320
The same, desulphurised	0.056	37.1	0.93	33.60	10.32	1.07	45.92	29.2	291

* B. Osann: "Lehrbuch der Eisen und Stahlgiesserei" (Text-book of Iron and Steel-founding), 5th ed. (1922), p. 152.

kinds, larger additions of cast iron scrap and an increasing silicon content being employed. These tests must, however, be conducted in the fore-hearth furnace (Dürkopp-Luyken-Rein) in order that the greatest possible uniformity in the degree of desulphurisation may be ensured.

The desulphurised cast iron shows remarkable behaviour in regard to wearing resistance. Particularly in tests with valve boxes and rings in locomotive construction it was found that those rings with the smallest sulphur content also showed the smallest amount of wear. This fact is by no means unusual, and the tests are being continued. In casting these piston rings attention must also be paid to the processes of solidification in order that cavities and graphite "nests" in the interior of the rings may be avoided.

The tests of the Institute for Iron Research also showed that the iron, after leaving the overflow in the Dürkopp-Luyken-Rein fore-hearth, no longer shows any sign of boiling *in vacuo* from the development of gas; a favourable effect has therefore been already produced by the removal of the slag in the cupola, and in certain cases any further desulphurisation to any extent in the fore-hearth is superfluous

Oberhoffer tested a hard cast iron which was desulphurised in the ladle. The results are given in Table II.

Oberhoffer has dealt in great detail with the importance of oxygen compounds in the iron in a lecture[1] delivered at the last general meeting of the Association of German Ironmasters. He also discussed the deterioration of cast iron owing to the oxygen content and furnished some remarkable series of figures on the subject. The influence of oxides appears not only in the welding and hardening capacity of the metal, but also in its magnetic and strength properties, most particularly in the case of grey cast iron.

As will be recognised from what has been said, the use of the desulphurising process is primarily advantageous in the case of cast iron. The process is also of importance in the production of malleable iron, as also of steel castings in small converters, when the iron melted in the shaft furnace can be already desulphurised. The tests regarding the two last-named processes have not yet been completed. The Walter process cannot be used directly in open hearth and electric furnaces; in the treatment of steel the additions can only be made in the ladle. The desulphurisation and degassification of grey cast iron can be effected without difficulty; in the case of white iron it is less successful. If the steel scrap melted in the cupola is enriched with silicon so that the iron becomes grey, the desulphurisation and distillation proceed just as in the case of high-carbon grey cast iron, for the silicon addition effects the separation of graphite and supplies the carbon necessary for conversion.

The results are derived from tests made at four different works. The series of figures 9 to 16 are the result of tests made by the Kaiser-Wilhelm Institute for Iron Research at the request of the Association of German Ironmasters on sample castings from the foundry of the Dürkoppwerke A.C., Bielefeld. For the communication of these results the author wishes here to express his best thanks.

The following is a list of firms and their representatives who have recently joined the British Cast Iron Research Association:—Alcock, Ashdown & Company, Bombay: E. C. B. Walton; Castings, Limited, Walsall: W. D. Bullows; Centrifugal Castings, Limited, Kilmarnock: J. E. Hurst; John Fowler (Don Foundry), Limited, Sheffield: W. T. Kitching; Linotype and Machinery, Limited, Altrincham, Cheshire: Sam Newton: Metropolitan-Vickers Electric Company, Limited, Manchester: W. Jolley; C. and B. Smith, Wolverhampton: Clifford R. Smith; J. Stone & Comapny, Limited, Deptford and Charlton, London: Wesley Lambert; Charles W. Taylor & Son, Limited, South Shields; C. R. R. Taylor; Turner, Morrison & Company, Limited, Calcutta: Alexander Cameron; John Wood & Sons, Limited, Wigan: Thomas Wood; and Kumardhubi Engineering Works, Limited, Calcutta: E. S. Tarlton.

[1] "On Oxygen in Iron": "Stahl und Eisen" shortly.

Death of an A.F.A. Past-President.

We regret to announce the death of Mr. A. O. Backert, the President of the Penton Publishing Company, and a past-president of the American Foundrymen's Association. Mr. Backert was at work at his office in Cleveland, Ohio, as late as last Friday, when he suddenly died from heart-failure. Mr. Backert visited England in April, 1919, as President of the American Foundrymen's

Mr. A. O. Backert.

Association, and was accorded complimentary dinners in Coventry, Birmingham and Sheffield; this was the first visit of this character.

The deceased gentleman acted as secretary-treasurer to the A.F.A. from 1914 to 1918, consolidating the work previously conducted by Dr. Moldenke. It is only some twelve months ago that he was elected president of the Penton concern. Mr. Backert made numerous friends in Great Britain, and invariably acted as host to any British foundryman visiting America.

Welsh Foundrymen Visit Tredomen Works.

Last Thursday about 24 members of the Wales and Monmouth Branch of the Institute of British Foundrymen visited the Tredomen Works of Messrs. Powell, Duffryn & Company, Limited, at Ystradmynach. Mr. A. E. Beanland, works manager, personally conducted the visitors through the works. Commencing with the pattern shops, the visitors successively inspected the forge, machine shops, and winding up with an inspection of the foundry. Mr. Fred Taylor, senior vice-president, and Mr. J. J. McLelland, the honorary secretary, voiced the appreciation the members felt at the opportunity which the Powell, Duffryn concern had afforded of inspecting one of the largest and most modern foundries in the Principality.

Lanz Pearlitic Cast Iron.—A further development in the production of cast iron of pearlitic structure by the Lanz process has been reached, and is the subject matter of British Patent Specification No. 217,885 relating to refined cast iron. This refining or improving of quality may be obtained by additions of nickel, chromium and the like elements well known in the refining of steel. By the addition of nickel, for instance, to the amount of 0.6 per cent., the formation of graphite will be affected approximately as though a similar amount of silicon had been added. In order to obtain a pearlitic structure, therefore, the moulds should be preheated correspondingly less, about 100 deg. C. in the above cited case.

Trade Talk.

THE OFFER of the Associated Lead Manufacturers for the ordinary and preference shares of the Brimsdown Lead Company has been accepted.

THE STATEMENT that the Dowlais Ironworks owned by Guest, Keen & Nettlefolds, Limited, are to be closed down indefinitely is without foundation.

NOTICES HAVE BEEN POSTED UP at the Llanelly Steel Company's works informing day men of all grades that half time only will be worked until further notice.

W. WHITWELL & COMPANY, LIMITED, have decided to close their Thornaby Ironworks at the end of the current week, when the establishment will be completely idle.

JAMES GORDON & COMPANY, LIMITED, Windsor House, Kingsway, London, W.C.2, are now acting as successors to the late Major S. Utting for the sale of the Thermix air heater and Emile Prat systems of mechanical draught.

THE NITRATE RAILWAYS COMPANY have awarded to Beyer, Peacock & Company, Limited, Gorton Foundry, Manchester, the contract for three large oil-burning locomotives of the "Garratt" patent articulated type. These locomotives will be of the 2—8—2, 2—8—2 wheel arrangement.

HARLAND & WOLFF, LIMITED, are at present constructing in their Belfast shops six sets of double acting eight-cylinder Diesel engines each of approximately 20,000 i.h.p. These are intended for the three 22,000 motor ships which they are building—two for the R.M.S.P. Co. and one for the Union Castle Line.

THE WOODALL DUCKHAM VERTICAL RETORT AND OVEN CONSTRUCTION COMPANY (1920), LIMITED, have an order for a tar dehydration plant (T.I.C. lead bath), to produce tar to the Road Board specification, for the Gas Department of the County Borough of Dewsbury. The plant has a capacity of 10 tons a day.

AUGUST'S MUFFLE FURNACES, LIMITED, Halifax, have received orders for Simpson intensive foundry mixers from John Fowler (Don Foundry), Limited, Sheffield, Barford & Perkins, Limited, Peterborough (this last to be direct driven by a "Bull" motor), and Macbeth Bros. & Company, Limited, Calcutta, India.

MR. J. T. BROWNLIE, president of the Amalgamated Engineering Union, addressing a meeting of the unemployed members of that union at Sunderland, urged that the invitation of the Shipbuilding Employers' Federation to trade unions in the industry to form a joint committee to investigate the costs of production, both outside and within the control of the industry, should be accepted.

THE MOTOR VESSEL building by the Fairfield Shipbuilding & Engineering Company, Limited, for Houlder Bros., will be fitted with Vickcen oil purifiers, for the purification of both fuel and lubricating oil of the main Diesel engines. This decision was reached after competitive trials, the tests being carried out on a range of fuel oils by independent umpires. Vickcen separators are handled by British Separators, Limited, 161, Queen's Road, Peckham, S.E.15.

THE WELLMAN SMITH OWEN ENGINEERING CORPORATION, LIMITED, amongst other contracts, have recently completed orders for their L type gas producer as follows: Seven for the Société Anonyme des Vereries de Vals-Labegude, Aubenas (Ardreche), France; six for the Skinningrove Iron Works of Pease & Partners, Limited. Orders have also been received for this type from the Acklam Iron and Steel Works (Dorman, Long & Company, Limited), Alfred Hickman, Limited, and the Australian Glass Works, the latter two contracts being repeat orders.

AT the thirteenth annual conference of the National Union of Stove Grate and General Metal Workers, Mr. E. Howarth (president) said the tide of unemployment had overwhelmed some of the Unions, and a great many of them, despite increased contributions, had been unable to continue to pay the benefits promised in their rules. Such, however, was not the case with them—the Stove Grate Workers. They had paid full benefits all the way through. At the end of 1922, the members numbered 3,622; in December, 1924, they had reached 4,100, and to-day the figures were 4,437 higher than ever before. In 1922, the total Funds amounted to £11,056, and in December, 1924, to £13,327.

AFTER DROPPING to a low figure in January, Czechoslovak iron exports showed a considerable revival in February, when the figures were higher than in any month since the Ruhr occupation. The total export was 36,800 tons, compared with 29,700 in January and a monthly average of 31,000 in the second half of 1924. Exports to England, Switzerland, Italy and Holland were above the monthly average of the past four years, while there was also an increase in the export to Germany. Over half the exports were finished goods, while semi-manufactured goods were 14 per cent. of the whole.

Obituary.

MR. G. GOODING, late of the firm of T. Lemon & Sons, engineers, John Street, Cardiff, died recently at Bridgwater. Prior to his retirement, in June last, he was a director of the firm.

MR. W. NORTH WALKER died on Friday last at Walsall. Mr. Walker was a director of the firm of Walker Bros., Ltd., ironmasters, of Walsall, Dudley and Netherton. He was about 48 years of age, and was the only son of the late Mr. R. G. Walker, formerly of Dudley and afterwards of Wednesbury.

MR. W. C. WHITE has died at his residence, Clifton Avenue, West Hartlepool. Mr. White was well known, particularly in commercial circles in West Hartlepool, and was generally held in high regard. As a boy he entered the employ of Ropner & Company, and when he retired from business about four years ago he was a director of that firm.

MR. A. JACOB, manager of the British Aluminium Company, Limited, since 1908, has died suddenly at the age of 57. In the course of his business career he has been associated with the British Thomson-Houston Company, Limited, the British Schuckert Electric Company, Limited, and Siemens Brothers Dynamo Works, Limited, and was a member of the Overhead Wires Committee of the British Engineering Standards Association, and the Overhead Wires Committee of the British Electrical Research Association.

Personal.

SIR VINCENT L. RAVEN has been elected president of the Institution of Mechanical Engineers for the 1925-26 session.

MR. H. LEATHERBARROW, managing director of Barrow, Brown & Company, Limited, Bangkok, Siam, and chairman of Central Motors (Siam), Limited, left Bangkok for Europe on April 3. His address when in England in about three weeks' time will be at the offices of the Allied National Corporation, Limited, 72-74, Victoria Street, London, S.W.1.

MR. GEORGE CHAUVIN has resigned the position of managing director of Siemens Brothers & Company, Limited, Caxton House, Westminster, London, S.W.1., owing to advancing years. Mr. Chauvin has held this position since April, 1899, during which time the works and manufacturing activities of the company have been very largely expanded, as indicated by its increased and paid-up capital which, including debenture stock, has been raised from £425,000 to £2,854,300. The company, however, will continue to have the benefit of his experience and advice, as he will retain his seat on the board. The directors have elected Mr. Francis Hird to succeed Mr. Chauvin as managing director. Mr. Hird has assisted Mr. Chauvin for many years in the management of the company, and for the past three years has held the post of general manager of the company.

Company News.

Brush Electrical Engineering Company, Limited.—Ordinary dividend, 10 per cent. for year.

Carnforth Hematite Iron Company, Limited.—Loss for 1924, £11,574; depreciation, £5,000; total debit balance, £136,003.

Bristowe's Engineering Works, Limited, St. Stephen's House, Victoria Embankment, S.W.1.—Capital £5,000 in £1 shares.

Halley's Industrial Motors, Limited.—Profit, £19,210; interest on notes, bank overdraft and bonds, and depreciation, £9,207; net profit, £10,003; debit brought forward, £170,407; debit at profit and loss reduced to £160,404.

H. H. Vivian & Company, Limited.—Profit, £2,800; debit balance brought in, £1,242; debenture interest, £1,350; carried forward, £208; £2,500 transferred from general reserve to special reserve for depreciation to cover this service.

G. D. Peters & Company, Limited.—Net profit, £12,300; brought forward, £2,241; available, £14,541; less income tax, £5,250; dividend on preference shares, 6 per cent. per annum for year, less tax, £6,975; carried forward, £2,316.

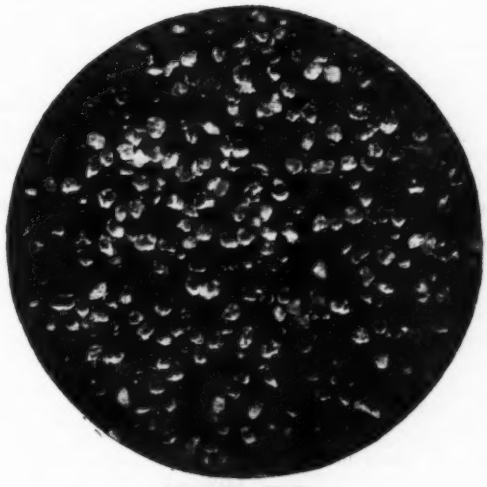
Fairbairn Lawson Combe Barbour, Limited.—Loss, £38,243; brought forward, £185,294; balance, £147,050; interim dividend, 2½ per cent. on preference shares; final ditto, 2½ per cent., making 5 per cent. for year; transfer £10,000 to note redemption account; carried forward, £122,050.

Cocksedge & Company, Limited.—Capital £50,000 in £1 shares (30,000 ordinary and 20,000 7½ per cent. cumulative preference). Structural and general engineers, etc. Directors: J. W. A. Cocksedge, 40, Tuddenham Road, Ipswich (chairman and manager), E. H. Cocksedge, 40, Tuddenham Road, Ipswich.

The Essential Properties of Sand for Oil Cores

Mr. C. W. Holmes, M.Met., the well-known foundry metallurgist, in his paper on "The Technical Side of Oil Cores," insisted that—

Core sand particles must be rounded and of regular size. Rounded grains give better venting properties than angular grains. Clean sand, i.e., free from clayey matter, requires less oil than do naturally-bonded or dirty sands.



RYARSH SAND.
20 magnifications.

The Ideal Sand for Oil Cores

must be more or less refractory, according to the class of casting to be made, it must be of uniform grain size, and it should be free from clayey material or organic matter.

RYARSH SAND

Possesses all these necessary properties

Full particulars from:

Ryarsh Sand Co., Ltd.

The Quarries, Ryarsh, Malling, Kent.

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IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The present outlook in the Cleveland iron trade can hardly be regarded from an optimistic standpoint, the volume of business transacted at recent markets being again on a most disappointing scale, barely removed, in fact, from retail in the weekly turnover. Home consumers' demands are still within narrow compass, and extreme caution is observed by buyers, while makers on the other hand, having largely restricted outputs, are disinclined to offer further substantial concessions to stimulate business. The export trade, though slightly better than at the corresponding period last month, continues sluggish, recent labour troubles having adversely affected the demand from Scandinavia, which has, also, of late been able to pick up cheap German supplies. Thus, notwithstanding the relative cheapness of Cleveland iron, compared with a few months ago, it is not making its way on the Continent as might have been expected. On 'Change last week 77s. was named for No. 3 G.M.B., with No. 1 82s., No. 4 foundry 76s., and No. 4 forge 75s. per ton.

No improvement can be recorded in the Tees-side hematite industry, with consequent further restriction of output, two additional furnaces in this district having been closed down last week. Values have also developed a still weaker tendency, with East Coast mixed numbers now quoted down to 82s. per ton, and No. 1 at 82s. 6d. On the North-West coast nominally Besseiner mixed numbers are quoted 87s. 6d. per ton, c.i.f. Welsh ports, 92s. 6d. per ton delivered at Glasgow, 97s. 6d. per ton delivered at Sheffield, and 100s. per ton delivered at Birmingham.

LANCASHIRE.—The present slow demand for castings in this district is naturally having a corresponding effect upon the local markets for foundry iron, with the result that transactions in this quality of pig are disappointing in volume, and prices have a weakening tendency. Sellers of foundry pig-iron seem to be rather more squeezable than they were. Ostensibly the Derbyshire ironmasters hold out for 77s. 6d. per ton at the furnaces for No. 3 foundry iron, or 85s. delivered at a Manchester station; but the market is not so absolutely steady at this price as it was. Local merchants believe that they can get a concession of 1s. per ton on the Derbyshire prices, but in the absence of any substantial business it is difficult to test this belief.

THE MIDLANDS.—Conditions in the chief centres of industry in this area continue unsatisfactory, the buying being mostly confined to small lots, as very few ironfounders are committing themselves for delivery ahead, even at the present low values in pig. There is no Continental foundry iron being consumed locally, as the price is still prohibitive. Ruling prices for pig-iron are as follow :—Derbyshire No. 3 foundry, 77s. 6d.; Staffordshire No. 3 foundry, 78s. to 80s.; Northants No. 3 foundry, 70s. to 71s.

SCOTLAND.—In the principal markets in this area business is at a very low ebb, and traders still see no sign of any change for the better. Under such conditions prices continue easy on the basis of 87s. 6d. for No. 3 foundry at the furnaces. Buyers are still content to take only the smallest quantities. Among the Falkirk founders there is just a shade more inquiry owing to contracts running out.

Finished Iron.

No relief has yet been experienced from the depression which has overtaken the various branches of industry indicated under the above heading, more especially as applying to the cheaper grades of bar iron. The local mills are, however, adhering to their figure of £12 10s. to £12 15s. for crown quality, and about £11 15s. for nut and bolt qualities, but are receiving little measure of support. Whilst this position obtains, it is not possible to see any material improvement in business. The makers of marked bars whose quotation remains at £15 per ton f.o.r. their works are only moderately busy, and very little tonnage of new business is being placed, although they have no fear of Continental competition for this grade.

Steel.

As had been anticipated for some time past, the steel manufacturers' price control scheme has now been suspended, as far as home markets are concerned, and makers are now free to adjust quotations without a fixed minimum. The full effect of this decision upon prices cannot yet be seen, but already there have been reductions from the recently ruling minimum figures of 5s. to 10s. per ton. It will no doubt bring some of the British prices to a level at which competition with Continental material in the home market is within the bounds of possibility, always considering the preference which is given to British steel when the difference in price is only moderate. At Sheffield, acid and basic billet production is being reduced. There is a falling off of steel orders for overseas. Crucible and electric steels are very poorly in demand, and although motor and railway steel continues to make a good showing, new orders are not coming along on a scale sufficient to keep works busy. Heavy engineering work is falling off, but in some of the lighter branches business is still on a fairly satisfactory scale.

Scrap.

Demand for all qualities of scrap metal continues extremely quiet all round, and in Lancashire markets last week purchases were only on a limited scale, ironfounders being very indifferent buyers. For the finest quality of textile scrap it is possible to get a better price, partly because it is comparatively scarce, and partly because it can sometimes be used instead of Scotch pig, and the price of the latter in Manchester is prohibitive. For this class of cast scrap some dealers ask 87s. 6d. per ton, but for ordinary scrap from 77s. 6d. to 82s. 6d. is about the present range of values. In Scotland, machinery cast iron is a little easy around 87s. 6d. per ton, and for ordinary quality in pieces not exceeding 1 cwt. 5s. per ton less. Steelworks cast-iron scrap in furnace sizes is now being picked up around 75s. to 77s. 6d. per ton. Cast-iron railway chairs are also easy at 85s. to 87s. 6d. per ton. Light cast-iron scrap and firebars have eased off, and sellers are now having difficulty in obtaining 71s. 3d. to 72s. 6d. per ton. The above prices are all per ton delivered f.o.t. consumers' works.

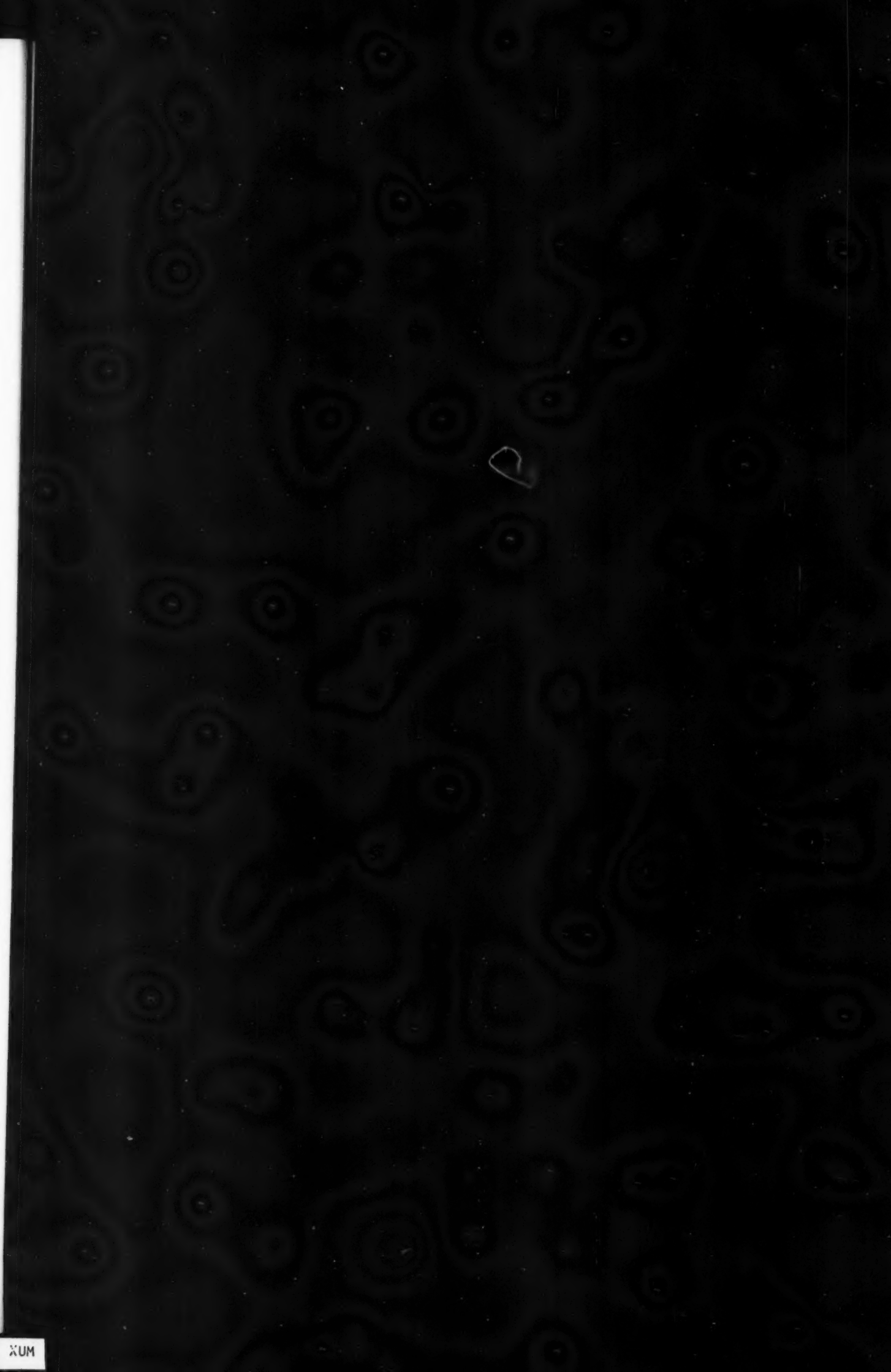
Metals.

Copper.—During the past week a much more cheerful tone has been in evidence in the market for standard copper, with values indicating a firmer tendency, due to more confident advices from America and a revival of buying on home consumers' account. Official figures disclose that in 1923 Europe consumed 38 per cent. less copper, while the rest of the world consumed 81 per cent. more copper than in 1913. If Europe's consumption was 550,841 tons, as the statistics quoted indicate, it was only 13 per cent. less than in 1913. A further increase of 16 per cent. this year would make Europe's copper consumption larger than it was in 1923. Current quotations :—*Cash* : Thursday, £60 7s. 6d.; Friday, £61 12s. 6d.; Monday, £61 7s. 6d.; Tuesday, £61 7s. 6d.; Wednesday, £61 7s. 6d.

Three Months : Thursday, £61 7s. 6d.; Friday, £62 12s. 6d.; Monday, £62 5s.; Tuesday, £62 7s. 6d.; Wednesday, £62 5s.

Tin.—A substantial improvement in Eastern values has been followed by a sharp recovery in the home market, with values of three months' metal showing a gain of several pounds. Sellers have been more reserved and, with sustained buying of July and three months, the market closed firm. The immediate outlook, however, is still rather obscure. Should repurchases by the "short" interest develop once more, the market is quite likely to respond freely, and indications point to another decrease in the visible supply at the end of the month, in spite of expected heavy Straits shipments, which have been estimated at over 6,000 tons. Current quotations :—*Cash* : Thursday, £242; Friday, £245 5s.; Monday, £244; Tuesday, £246 2s. 6d.; Wednesday, £249 15s.

Three Months : Thursday, £244 10s.; Friday, £247 10s.; Monday, £246 2s. 6d.; Tuesday, £248 5s.; Wednesday, £251 15s.

Spelter.—The market for this metal has developed a rather steadier tendency, with forward metal at slightly increased values. In their weekly circular Rudolf Wolff & Company state : Not much interest has been shown in spelter, and inquiries from consumers continue only on a small scale. A few lots of Belgian spelter have been offered, and owing to poor consumption in Germany, stocks are accumulating there, although as yet they have not been pressed on our market. Current quotations :—*Ordinary* : Thursday, £35 10s.; Friday, £35 3s. 9d.; Monday, £34 13s. 9d.; Tuesday, £34 12s. 6d.; Wednesday, £34 12s. 6d.

Lead.—Some improvement in demand may be noted in soft foreign pig, and with lighter offerings values have hardened. According to the Metal Exchange official returns, the apparent consumption of imported pig-lead during March was 20,020 tons, compared with 17,052 tons in February and 19,970 tons in January. Current quotations :—*Soft foreign (prompt)* : Thursday, £32 10s.; Friday, £33 17s. 6d.; Monday, £33 7s. 6d.; Tuesday, £33 2s. 6d.; Wednesday, £32 13s. 9d.